Chapter 2: Background Information

2.1 Introduction to Plains Bison

In 2010, FWP began the process of evaluating the opportunity for establishing a wild Plains Bison population somewhere within the state. As part of the evaluation process a public background document, *Background Information on Issues of Concern for Montana: Plains Bison Ecology, Management, and Conservation*, was created to compile the current body of knowledge pertaining to bison with an emphasis on issues most pertinent in Montana. The purpose of the background document was not to make management recommendations or decisions, but rather to create the foundation for an informed public dialogue about the future of bison in the state of Montana. For a more thorough examination of the subjects that are presented below, please refer to the complete background document. It is available on the FWP website (www.FWP.mt.gov). The following includes new information that has become available since completion of the background document.

2.1.1 Taxonomy and Systematics

The North American bison belongs to the genus of *Bison,* which is a separate genus from cattle (*Bos*). Traditionally, within the *Bison* genus there are two recognized subspecies, Plains Bison (*Bison bison bison*) and Wood Bison (*Bison bison athabascae*). The term bison within this document, unless otherwise specified, refers to Plains Bison.

2.1.2 Species Description

Bison are the largest terrestrial mammal in North America; however, the weight and measurements of bison differ considerably by age, sex, and among different populations. Males, referred to as bulls, average between 1,000 and 2,000 pounds, and females, known as cows, average between 800 and 1,000 pounds. Despite their large stature bison are extremely agile, with the ability to reach substantial speeds of approximately 30 to 35 mph, and jump up to six feet high (USFWS, 1997; Lott, 2002).

The head and front legs of a mature bison are covered with dense chocolate-colored hair. Bison hair is thinner than that of cattle, but is much denser with bison having "about ten times more hair per square inch of hide than do modern cattle" (Brink, 2008, p. 172). This hair plays a crucial role in insulating bison against extreme environmental conditions, as well as protecting bison from predatory attacks and injuries that may occur during male competition.

2.1.3 Historical Distribution

The historic distribution of bison covered most of the North American continent (Hornaday, 1889; Gates et al., 2010), however the largest concentration of bison occupied the Great Plains, which extends east to the Missouri River valley and west to the Front Range of the Rocky Mountains (Guthrie, 1980). Bison were primarily located in the lower elevations of the plains, although there are numerous reports of bison seasonally moving into mountain valleys and higher elevations within the Rocky Mountains (e.g. Fryxell, 1926).

2.1.4 Historical Abundance

Historical estimates as to the abundance of bison present at one time on the Great Plains have ranged from 15 to 100 million bison (Dary, 1989; Shaw, 1995). Recent studies of the environmental limitations of the semiarid grasslands that make up the Great Plains have lowered the estimated abundance of bison to no more than 30 million (Isenberg, 2000).

Bison were historically found throughout most of Montana. The observations of early travelers within the region, archeological records of a variety of bison kill sites, and the oral history of Native Americans support the estimates of historical distribution and abundance of bison. Figure 1 illustrates the inferred late prehistoric and early historical relative distribution and densities of bison within the state of Montana. Though populations of bison were found throughout much of the state, some regions had larger estimated year-round populations and higher population densities (Figure 1).

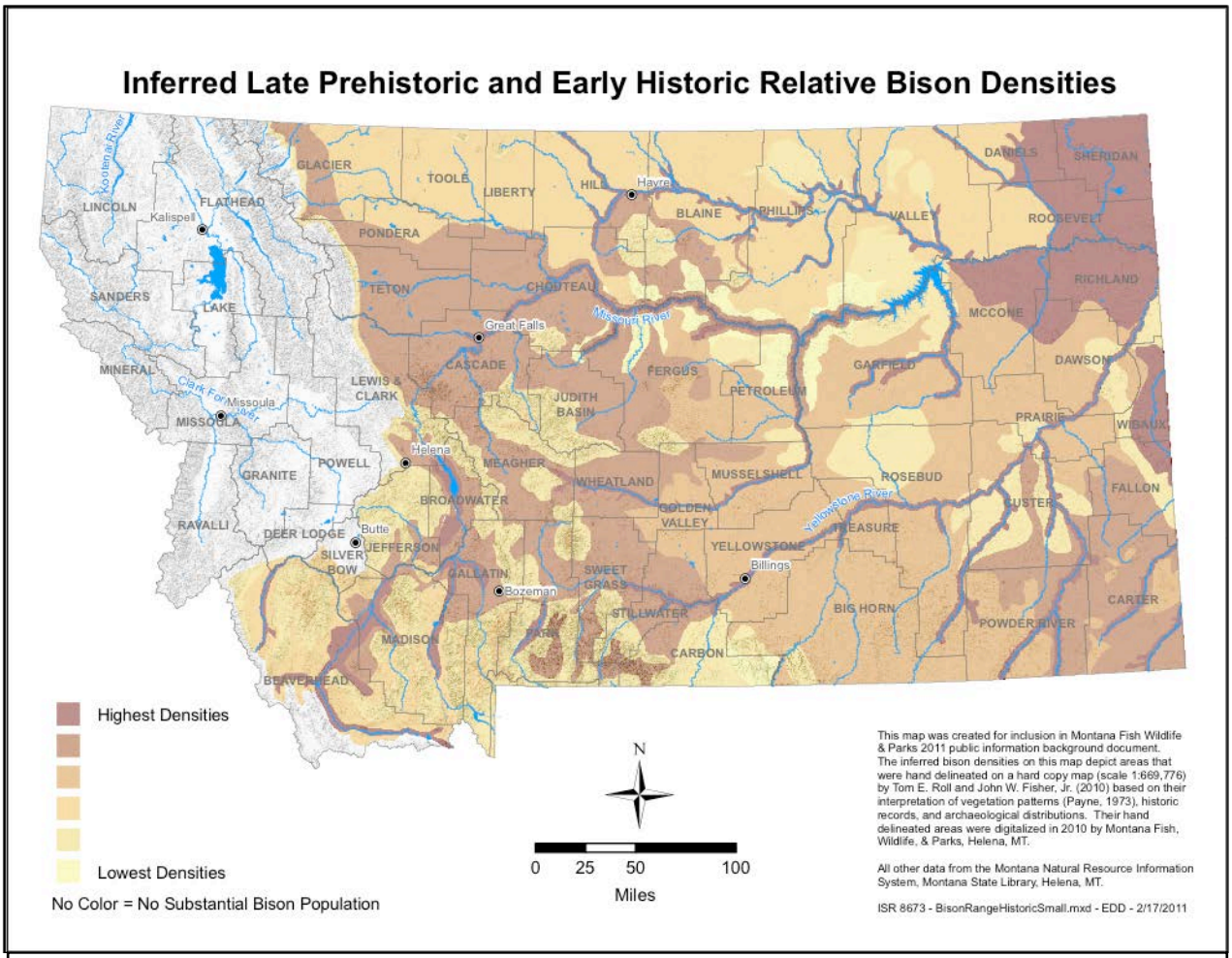

Figure 1: Inferred late prehistoric and early historic relative bison densities. Created by Roll and Fisher Jr. (2010).

Native American oral history, early explorer reports, and the observation of remains indicate that there were small populations of bison west of the continental divide. Analysis of the historical ecological makeup of the habitat of the western portion of Montana however, does not support the existence of large bison herds like those found to the east of the Rocky Mountains (Daubenmire, 1895; Mack and Thompson, 1982; Flores, 1996).

2.2 Species Status, Distribution, and Abundance

The status, distribution, and abundance of bison differs within the United States, Canada, and Mexico. North American bison have been listed as "Near Threatened" by the International Union for Conservation of Nature (IUCN). The IUCN has been assessing the conservation status of species on a global scale for the past 50 years. As of 2008, it was estimated that there were currently 20,504 Plains Bison in 62 conservation herds within the United States and Canada. Of those 62 conservation herds, 87% are believed to be within the original range of Plains Bison (Gates et al., 2010).

An important factor in evaluating the current status of bison is an examination of the number of bison within a herd compared to the number of individual bison that genetics experts recommend to conserve the genetic health of the species. A simulation model demonstrates that under ideal management conditions a bison population of 400 is likely to retain 90% of its current genetic diversity with a 90% probability for 200 years (Gross and Wang, 2005). Another simulation model found that a herd that fluctuates between 2,000 and 3,000 bison will lose an estimated 5% of genetic diversity each century through genetic drift (Perez-Figueroa et. al, 2010). In order to ensure that management does not impact the viability of herd genetics, experts recommend that conservation herds be maintained close to 1,000 animals in order to maintain a viable population (Freese et al., 2007; Dratch and Gogan, 2010; Gates et al., 2010, American Bison Society, 2011). Hedrick (2009) notes that herds should have an effective breeding population of 1,000, which would require a total population of 2,000-3,000 to avoid the impacts of inbreeding and to maintain genetic variation. Currently there are only five Plains Bison conservation herds that have over 1,000 individuals and 74% of Plains Bison conservation herds have populations of less than 400 individuals, with 32% having fewer than 50 (Boyd, 2003; Gates et al., 2010).

As of 2013, bison are listed by the Montana Natural Heritage Program (MNHP) and FWP as a "Species of Concern". Species of Concern "are native Montana animals that are considered to be 'at risk' due to declining population trends, threats to their habitat, and/or restricted distribution" (MNHP, 2010). FWP and MNHP have given bison an S2 state ranking and a G4 global ranking (MNHP, 2010; FWP, 2010a). An S2 status means the species is "at risk because of very limited and/or potentially declining population numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state" (FWP and MNHP; 2010b). The G4 global ranking means that the species is "apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining" (FWP and MNHP, 2010b). FWP has a clear obligation to use its resources to implement conservation actions that provide direct benefit to these species, communities, and focus areas" (FWP, 2005, p. 32).

Within Montana there is one public captive conservation herd, which resides within the National Bison Range (NBR) and is co-managed by the United States Fish and Wildlife Service (USFWS) and the Confederated Salish and Kootenai Tribes (CSKT). This is an actively managed herd, which is on a rotational grazing system and is annually rounded up to remove surplus animals and test for disease. The herd is managed at approximately 400 bison on 18,500 fenced acres. Surplus bison are culled through livestock sales and transfer to other tribes. Testing of the NBR herd found the presence of cattle DNA, both in mitochondrial DNA and in nuclear DNA (Ward, 2000).

The wild bison that inhabit YNP exhibit limited seasonal movement beyond park boundaries into neighboring regions of Montana. This population is considered to be the only population of Plains Bison that has continuously existed in the wild in North America. During the fall of 2014, the bison population of YNP was estimated at approximately 4,900. Over 700 bison were either culled or harvested by hunters in the winter of 2014-2015.

The bison that originate from the YNP herds have been designated as a species in need of disease management within the state of Montana and are managed under the IBMP (§87-1-216 MCA). The primary goals of the IBMP are "to maintain a wild, free-ranging population of bison and address the risk of brucellosis transmission to protect the economic interest and viability of the livestock industry in Montana" (IBMP, 2000, p. 1). Under current IBMP management, bison originating within YNP are not permitted to maintain a year-round population or presence in Montana and are actively moved back into the park by government officials, with the exception of those found in the Absaroka-Beartooth Wilderness. Under the IBMP, bison may freely migrate into the Absaroka-Beartooth Wilderness north of Yellowstone, including the upper portions of Hellroaring and Slough Creek, though the IBMP recognizes that due to the high elevations and rugged topography, few bison are expected to utilize this region.

Several adaptive management adjustments have increased the tolerance of bison in areas outside the Park since the original IBMP. Any management adjustments ensure that the agencies will "evaluate the effects of these adjustments and modify as necessary to… minimize the risk of transmission of brucellosis to livestock" (IBMP, 2011).

In March 2015, YNP and the state of Montana began a scoping process in preparation for a new EIS to revise the IBMP. While the existing plan from 2000 and associated adjustments has been effective at preventing brucellosis transmission and maintaining a viable herd, new data about general biology and disease prevalence, new federal rules relative to disease, public opinion shifting toward more tolerance for bison in Montana, and other changing circumstances justify a plan revision. (Visit http://www.ibmp.info for more information regarding the IBMP.)

2.3 Life History and Ecology

2.3.1 Description of Relevant Bison Behavior and Habitat

It is important to note that much of what is known about how bison may use different landscapes in Montana comes from historical observations, as bison were removed from

the state before European settlement. There are many unknowns about how a bison herd may behave and use any particular location in modern day Montana.

Bison were found throughout the prairies, arid plains and grasslands, meadows, river valleys, aspen parklands, coniferous forests, woodlands, and openings in boreal forests. There are also historical reports of mountain bison, which were Plains Bison that resided in high mountain habitats.

Bison will congregate in larger herds mainly during the summer breeding season, and primarily in favorable feeding habitat (Nowak and Paradiso, 1983; Bamforth, 1987; Berger and Cunningham, 1994a; Aune et al., 1998; Isenberg, 2000). Throughout the remainder of the year cows, calves, and immature males tend to form smaller "cow" groups averaging between 10 and 20 individuals (McHugh, 1972; Nowak and Paradiso, 1983; Isenberg, 2000; Long, 2003; Picton, 2005; FWP and MNHP, 2010a). The bulls tend to remain solitary or form small groups of up to five bulls during most of the year, joining with the cow groups only during the breeding season.

The type of habitat that a herd occupies can also have an effect on its size. Group sizes tend to be smaller in mountainous or mixed terrain than in open prairie (McHugh, 1972; Berger and Cunningham, 1994a; Gates et al., 2010). Historical reports indicate that the 'mountain' bison of YNP congregated usually in bands of 5-30, rarely more (Meagher, 1973). Observations indicate that habitat seemed to have a greater effect on the size of cow groups than bull groups. Herds using ravines and rolling hills were about half the size of herds using prairie habitats (Berger and Cunningham, 1994a). Bison are also known to congregate in larger groups around permanent sources of water, but then will separate to feed (Bamforth, 1987). Bison density averages from one to four per square mile depending on the range conditions (Long, 2003).

The home range of wild bison varies primarily with habitat productivity. As grassland ungulates, bison must modify their behavior to withstand wide spatial variations in resource quality and availability. The average home range of a bison herd extends from 18 to 62 square miles depending on the season and the quality of forage (Nowak and Paradiso, 1983; Long, 2003). Herds utilize smaller home ranges during the summer months and larger ranges during the winter. When in habitat of lower productivity, bison will increase the size of their home range. Bison move frequently within their home ranges, and tend to travel around 1.8 miles daily (Nowak and Paradiso, 1983; Long, 2003).

Historically some bison herds may have migrated a few hundred miles south in search of higher-quality winter habitat (Nowak and Paradiso, 1983; Long, 2003), but it does not appear bison "migrated" in the traditional sense if migration is defined as following a regular and predictable seasonal or annual route (Garretson, 1938; Roe 1970; Hart, 2001). The migration patterns of bison simply are not consistent from year to year (Meagher, 1973; Van Vuren, 1980; Nowak and Paradiso, 1983; Bamforth, 1987; Coppedge et al. 1999; Knapp et al., 1999; Lott, 2002; Long, 2003).

Migration is closely associated with locations of permanent water and forage quantity and quality due to seasonal changes and precipitation patterns. Bison appeared to move in response to local conditions of forage availability, as influenced by weather, fire, and previous grazing (Moodie & Ray, 1976; Hart, 2001). Historically fire, hunting pressure, and plagues of grasshoppers or locusts had a large impact on the migration of bison (Moodie & Ray, 1976).

It appears that bison are more likely to engage in seasonal altitudinal migration rather than in a large north-south migration. In northern regions, bison moved east-west seasonally from the plains into the bordering aspen parklands and rough country of the foot hills during winter weather, but not north-south (Garretson, 1938; Hart, 2001). Historical evidence indicates that "buffalo sheltered in the wooded areas in the coldest months of winter and, from spring until early winter, grazed on the open grasslands" (Moodie & Ray, 1976, p.46). Historically a large number of bison wintered on the northern plains. "Typical winter sheltering spots for bison included deep valleys of rivers, creeks, and coulees, thick groves of trees and brush, and hilly or broken country where there are options to move out of the wind" (Brink, 2008, pp. 62–63).

Bison would begin to move back out onto the plains as winter transitioned to spring. "Herds moved out of sheltered valleys and hilly country but stayed close enough to move back in case of all-too-common late winter storms" (Brink, 2008, p. 64). "In summer, especially late summer, water became the critical resource" (Flores, 1996, p. 7). During her study of bison in YNP, Meagher (1973) observed that during the spring bison moved from lower wintering valleys to higher summer ranges, and would then reverse this altitudinal migration in the fall.

Bison engage in non-grazing behavior, including wallowing and horning that influence grassland dynamics and are different from cattle behavior (McMillan & Pfeiffer, 2011). Long-term controlled studies comparing rangeland cattle and bison have found that higher levels of biodiversity are more commonly associated with bison occupation (Fox et al., 2012; Town et al., 2005). Bison presence also tends to maintain tall-grass prairies at higher levels of local and regional diversity than cattle (McMillan & Pfeiffer, 2011). Due to the differences in the non-grazing behavior of bison and cattle the species are not ecologically functional equivalents (McMillan & Pfeiffer, 2011).

Bison of all ages and sex classes engage in a behavior called wallowing, which involves rolling in soft dirt while scraping their horns and hooves against the ground (McMillan et al., 2000; Reynolds et al., 2003; Gates et al., 2010). This behavior forms a circular to oval-shaped bare soil depression (Coppedge et al., 1999) that collects rainwater and creates a microenvironment that supports species that differ from the rest of the ecosystem. The life span of wallows depends on how often they are used, the type of soil, and the size of the disturbance.

Bison of all age and sex classes also engage in a behavior referred to as horning, which involves the rubbing of an object with the head, horns, neck, or shoulders. Horning typically

involves rubbing on a shrub or small tree, though bison may utilize man-made objects as well.

2.3.2 Foraging Ecology and Diet Composition

Bison are ruminants with a four-chambered stomach system that allows them to effectively digest plant material. Bison typically forage between 9 to 11 hours daily, but will increase their foraging if the quality of food is low. Bison alternate between active foraging and passive ruminating to allow time for the microorganisms in their gut to break down the plant material. The large size of the bison allows for a larger digestion vat, thereby allowing bison to utilize lower-quality forage than other ungulates, such as elk, deer, and cattle (e.g., Peden et al., 1974).

Bison and cattle differ in the elevation and degree of slope in which they graze, with bison more often grazing on steeper slopes (Van Vuren, 2001). Cattle and bison display different foraging behaviors, with bison behaving more as energy maximizers (Nelson, 1965; Peden et al.,1974; Norland, 1984; Van Vuren, 2001; Fuhlendorf et al., 2010). During a study of bison in Theodore Roosevelt National Park, Norland (1984) observed that bison did not center foraging activities around permanent water sources, but were instead highly mobile in order to use different water sources. Bison also used temporary water sources, went without water for at least one day, and used snow instead of water when available. The increase of vertical distance from water caused a steep decline in cattle foraging; however, the situation resulted in only a slight decrease in bison foraging (Van Vuren, 2001).

The diet of the Plains Bison consists primarily of grasses, though bison will consume forbs and woody vegetation when their preferred vegetation is not readily available (Nowak and Paradiso, 1983; Foresman, 2001; Long, 2003; Burde and Feldhamer, 2005; Picton 2005). Bison's nutritional needs change seasonally and are related to the length of the day, with a metabolic rate decrease in the fall and winter. A mature bison gains and loses weight cyclically, with weight loss occurring in the fall and winter, and weight gain occurring in the spring and summer (Feist, 1999).

Bison have evolved the ability to plow away up to 18 inches of snow with their large low-hanging head in order to access the underlying vegetation (Meagher, 1978; Picton, 2005). This adaptation allows bison to effectively feed on natural sources during the winter season in conditions that may limit the foraging ability of other wild ungulates and may require the diet of domestic livestock to be supplemented.

2.3.3 Reproductive Biology

A female bison's ability to produce viable offspring is dependent on a number of factors including age, physical condition, and disease status. The age that a female first conceives varies among individuals and herd location (Reynolds et al., 2003). Females commonly conceive at two years of age and thus produce their first calf when they are three years old. Prime breeding years differ between herds, but tend to range from four to ten years of age (Berger and Cunningham, 1994a; Aune et al., 1998; Gates et al., 2010). The majority of males begin to reach sexual maturity in their second or third year; however, bulls that are

less than six years old tend to not yet possess the social maturity to successfully compete with other bulls for the opportunity to breed (Meagher, 1973; Reynolds et al., 2003; Picton, 2005). Bulls that are between seven and eight years old are the most competitive males, and therefore have the highest breeding success.

The breeding season of bison, which is referred to as the rut, tends to occur between July and September, with the majority of breeding occurring in July and August. A male bison will attempt to breed with as many females as possible during each breeding season in order to increase the number of viable offspring that carry his genes. Gestation and calving seasons can be influenced by factors such as location and climatic conditions (Aune et al., 1998; Reynolds et al., 2003; Gogan et al., 2005). Gestation in bison ranges from 9 to 9.5 months with the availability of spring forage being a major factor in the timing of births.

A cow delivers a single reddish tan calf, which is able to stand and suckle shortly after birth. Calves begin to graze after their first month, and learn food selection through observing the herd. Most calves are weaned within 8 to 12 months.

2.3.4 Demography and Population Dynamics

The rate of population growth is influenced by a variety of factors to include: sex ratio, age structure, quality and quantity of forage and habitat, and the immigration and emigration rate combined with the reproductive and mortality rates. The survival rate of calves varies dramatically across different populations, whereas adult survival rates are generally higher and less variable (Brodie, 2008). Survival rates for prime age adults are approximately 95% (Gates et al., 2010). Mortality may occur through predation, hunting, accidental drowning, parasites, and disease.

Another major factor that causes mortality in bison is climate. Winters with above-average snowfall and long freezes result in mortality in bison, as these conditions reduce foraging ability leading to poor animal condition and potentially death (Reynolds et al., 2003).

Pregnancy and birth rates vary within different herds and are affected by multiple factors including range condition, female body condition, and disease. While female bison may get pregnant most years, they do not always produce viable calves depending upon the severity of the previous winter (Aune et al., 1998). Calf survival varies drastically across different populations, but on average ranges from 40 to 90%, depending upon the severity of winter, predation pressures, and forage availability (Brodie, 2008; Gates et al., 2010).

The growth rate of bison populations is highly tied to adult survival, with small changes in adult survival having large effects on population growth rate (Fuller et al., 2007b). Growth rates tend to be highest in captive herds where there is an absence of predation, supplemental feeding, annual culling of surplus animals, and a sex ratio skewed to more females. Within wild populations, growth tends to occur at a slower rate (Gates et al., 2010).

2.3.5 Genetics

The genetic health of bison is one of the main focuses of their management as bison have undergone artificial hybridization with domestic cattle, been selectively bred for certain traits in private herds, undergone a vast reduction in population, and have been separated into small isolated populations. The modern Plains Bison descended from fewer than 500 animals that survived the extermination efforts of the late 1880s. The limited number of founder bison could have a large effect on the genetic variation of present-day herds, both public and private. Yet, recent studies have shown that reduction of the overall genetic diversity of bison may not have occurred to as great an extent as originally believed (Dratch and Gogan, 2010; Gates et al., 2010). Historically, the bison population did go through a severe bottleneck, but the population did not remain at low numbers for an extended period of time, and therefore modern populations appear to have retained a substantial amount of genetic diversity (Freese et al., 2007).

As noted in Bailey (2013), genetic extinction of the wild bison genotype has been occurring through five processes. These include: 1) initiating herds with few individuals having limited genetic diversity; 2) cross breeding with cattle genes; 3) inbreeding in small herds, 4) genetic drift in small populations; and 5) artificial selection by human intervention resulting in genotypic adaption to a captive or semi-captive environment. These factors have significant implications for the long term conservation of bison as wildlife.

An important factor in the conservation of genetic diversity within a bison population is the size of the herd and the sex ratio. There is a greater loss of genetic variation when the number of breeding animals is low (Dratch and Gogan, 2010). It is recommended that in order for a population to be considered of sufficient size for genetic purposes there should be over 1,000 animals and the size of the population should remain stable over time (Dratch and Gogan, 2010; American Bison Society, 2011). The American Bison Society (2011) prepared a number of recommendations following a meeting of genetics experts and bison managers. One recommendation is that conservation herds should be managed to retain maximum genetic variation thereby conserving the adaptive capacity and evolutionary potential of bison. Where possible, extraordinary efforts should be made to build conservation herds to an effective population size of at least 1,000 animals (American Bison Society, 2011).

Recognizing that many locations may not be suitable for herds over 1,000, it is recommended that a herd should have at least 400 animals to maintain 90% of its current genetic diversity with a 90% probability for 200 years (Gross and Wang, 2005) and the size of the overall population should remain stable over time. Geneticists recommend that any herd under 1,000 animals be actively managed to preserve genetic integrity (Dratch and Gogan, 2010; Gates et al., 2010). One way to manage for an increase in genetic diversity is to develop a metapopulation structure that allows for movement of individual bison between herds, thus allowing genetic variation to flow between the herds (Dratch and Gogan, 2010). It is also important that there be a sex ratio that is closer to 50:50 in order to allow competition between breeding bulls (Dratch and Gogan, 2010; Gates et al., 2010).

The Department of the Interior (DOI) Bison Conservation and Management group held the Bison Conservation Genetics Workshop in September 2008. The result of the workshop was an agreement on the basic tenets of genetic management for the USDI herds and discussion of different approaches to achieve these goals (Dratch and Gogan, 2010). The workshop participants established the criteria for a wild bison herd "as one with a large enough population size to prevent loss of genetic variation and with low levels of cattle or subspecies introgression, and subject to some of the forces of natural selection, including competition for breeding opportunities" (Dratch and Gogan, 2010, p. 2). Participants agreed that the desired minimum size of a population should be 1,000 individuals, which could be achieved through the establishment of a single population or the management of several smaller populations as a metapopulation (Dratch and Gogan, 2010). The participants evaluated the current status of the DOI herds and noted that while the herds meet the basic threshold for genetic integrity, most are managed well below 1,000 bison, and there are no management plans in place to manage these smaller herds as metapopulations (Dratch and Gogan, 2010).

The group also reached consensus that herds with no evidence of cattle hybridization must be safeguarded from potential introgression of livestock genes, and must be recognized as very important resources (Dratch and Gogan, 2010). The participants noted that while none of the DOI herds are subject to the full range of historic natural selective forces that influence genetic variation, management actions should maximize population size, minimize selection for docility and other traits related to domestication, strive for an even sex ratio considering differential survival, and minimally interfere with social behavior (Dratch and Gogan, 2010). Participants further recognized that DOI herds have a 'crucially important' role in long-term bison conservation (Dratch and Gogan, 2010). They noted that almost all DOI herds must be increased in size to avoid negative genetic effects, and since most of the herds are generally at or near capacity within federal boundaries, establishing satellite herds that can contribute to metapopulations is an important first step. Managing bison herds across current jurisdictional boundaries is also an important step to long-term bison conservation (Dratch and Gogan, 2010).

Bison and cattle do not naturally hybridize (e.g., Halbert and Derr, 2007), though breeding can be forced in captivity. When the bison population was extremely low, hybridization of bison and domestic cattle was attempted by early ranchers as a means to create offspring that exhibited the ruggedness and winter foraging ability of the bison and the meat production of the domestic cow.

The breeding of bison and cattle has caused an introgression of cattle genes into bison herds, which is a gene flow between populations that results from the hybrid offspring being bred back to the parental population (Boyd and Gates, 2006). The genetic integrity and natural genetic diversity of the species is compromised, as the introgressed DNA replaces portions of the original genome (Gates et al., 2010). While wild bison do not readily breed with domestic cattle, breeding can occur between the two species in captive and artificial settings. The majority of domestic bison producers no longer attempt hybridization (Boyd, 1914; Dary, 1989; Geist, 1996; Boyd and Gates, 2006).

Due to the limited number of bison in the early 20th century a significant number of both private and public herds were established or supplemented with bison that originated from herds that had a history of hybridization (Boyd and Gates, 2006). There has been a substantial effort to genetically test conservation herds in order to gain a better understanding of the genetic health of Plains Bison. When testing for cattle gene introgression in bison, there are two separate types of DNA that can be analyzed; mitochondrial DNA (mtDNA) and nuclear or autosomal DNA (nuclear DNA). There is evidence of cattle gene introgression in both mtDNA and nuclear DNA within public and private Plains Bison herds (Polziehn et al, 1995; Ward et al., 1999; Halbert and Derr, 2007; Dratch and Gogan, 2010). In herds where there are low amounts of cattle gene introgression, individual bison that have been identified as having domestic cattle ancestry through molecular markers have not been reported to be observably different than bison without domestic cattle ancestry (Hedrick, 2009).

The effects that cattle genes have on an individual bison are still being examined, but there are many managers and scientists that feel even bison herds with low levels of cattle-gene introgression can be of high conservation value when managed according to conservation criteria. Indicators of success such as restoring ecological function, adaptability, and natural selection should take priority over measures of genetic purity when bison free of cattle gene introgression are unavailable for restoration (American Bison Society, 2011).

DNA technological advances are displaying a greater prevalence of cattle gene introgression than previously documented and the genetic status of existing herds is ever changing with new techniques. At this point in time, only two public herds are currently considered free of cattle introgression, the YNP herd and the Elk Island herd in Alberta, Canada. The Henry Mountains herd in Utah is also considered free of cattle introgression, though limited testing has occurred. Private herds such as Turner Enterprise's Castle Rock herd in New Mexico and the American Prairie Reserve's (APR) herd are considered free of cattle gene introgression (Turner Enterprises Inc., pers. comm.; D. Jorgensen, WWF, pers. comm.). The Castle Rock herd descended from bison that were transferred in the 1930s from Yellowstone National Park (YNP) (Gates et al., 2010). The APR herd originated from Elk Island.

The bison in existence today that are likely to be free of cattle genes comprise only a fraction of the overall Plains Bison population. Managers of some of the privately owned and public herds are working to implement test and cull management practices in order to increase the genetic purity of their respective herds.

2.3.6 Reportable Diseases

As with any species, wild or domestic, bison may carry a number of pathogens or parasites. The following section examines the diseases that have the potential to infect bison, are transmissible to livestock, and are "reportable" within the state of Montana. It is important to note that many existing restoration herds are free of reportable diseases of concern, and therefore source bison for new herds can be obtained that are free of reportable diseases.

Diseases of concern discussed below can be managed within wild herds and are often absent in wild bison populations. The use of hunter test kits has been successful in monitoring for diseases of concern. For example the House Rock herd in Arizona, the Delta bison herd in Alaska, and the Henry Mountains Herd in Utah are all actively monitored for brucellosis from hunter-collected blood samples. None of the herds have shown any evidence of brucellosis or other diseases of concern to date. The Utah Division of Wildlife Resources captures and tests a certain percentage of bison in the Book Cliff herd on an annual basis for brucellosis. The herd is currently free of reportable disease. Wyoming Game & Fish has a mandatory hunter test kit return program that has a return success rate of 98%.

Many of the management agencies with restoration herds have disease contingency plans in place. The goal of these plans is to establish procedures to quickly and effectively respond should a disease of concern be detected. Often these contingency plans are developed in conjunction with the state veterinarian or Department of Livestock. The Delta bison herd plan, for example, is designed to respond to diseases that are transmitted from livestock to bison or vice versa. "Diseases with relatively mild symptoms that do not present a significant risk to bison, livestock or other wildlife species will be monitored by the serologic survey" (DeBois and Rogers, 2000, p. 14). "Diseases that produce moderately severe symptoms in bison and/or diseases of unknown pathology for other wildlife will also be monitored with a serologic survey. In addition, the Department may limit contact between bison, livestock and other wildlife species by managing the Delta bison herd for fewer bison" (p. 14). "Diseases that produce extremely severe symptoms that may be devastating for bison, livestock and/or other wildlife species may require reducing the risk of transmission from bison to livestock or other wildlife by one or more of the following actions: 1) Place a portion or all of the herd in captivity and test them for the disease, slaughter infected animals or use disease-free captive bison to reestablish the herd; 2) Slaughter the existing herd and re-establish with disease-free bison" (DeBois and Rogers, 2000, p. 14).

In addition to the reportable diseases that are reviewed below, bison have the potential to become infected with other diseases. One such disease that has an impact on bison, but is not a reportable disease of concern for livestock in Montana is Mycoplasma bovis. Mycoplasma bovis was responsible for a large number of bison deaths on a private bison ranch in Montana in 2011.

Anthrax

Anthrax is a disease caused by a spore-forming bacterium, *Bacillus anthracis,* (MDOL, 2010a). The bacteria can affect all mammals, but ruminants such as cattle, sheep, bison, and goats are the most susceptible (MDOL, 2010a). Anthrax is a zoonotic disease, which means that it is possible for humans to become infected with the cutaneous form, known as Wool-sorters disease, from close contact with infected animals or their by-products, such as heads or hides (Gates et al., 2010; MDOL, 2010a; J. Rankin, MDOL, pers. comm.). Anthrax spores exist in soil, and tend to grow and contaminate the soil surface following periods of precipitation and cooler weather that are followed by extended periods of hot, dry conditions (van Ness, 1971; MDOL, 2010a). Anthrax may be spread throughout a region by

streams, insects, animals and birds, animal waste, disturbed carcasses, wastewater effluent from water treatment plants, or inadequately sterilized bone meal and fertilizers made from contaminated material (Hugh-Jones and Hussaini, 1975; Gates et al., 2010; MDOL, 2010a). An animal may become infected through the ingestion of spores in contaminated food and water, or through inhalation (Gates et al., 2010; MDOL, 2010a).

Anthrax infection can be determined through testing, and may be treatable in captive bison and livestock with antimicrobials, such as penicillin and oxytetracycline (MDOL, 2010a; Gates et al., 2010). Although anthrax is not treatable in free-ranging wildlife, there are effective vaccines for captive bison and livestock (MDOL, 2010a; Gates et al., 2010).

Anthrax outbreaks occurred in herds of domestic cattle in Montana in Roosevelt County in 2005, and in two isolated regions of eastern Montana in 1999 (MDOL, 2010a). An outbreak of anthrax occurred in domestic bison in 2008 within a private herd in Gallatin County, killing over 287 bison (Ronnow, 2008; Person, 2010a). The ranch began a program of vaccination, and did not experience additional deaths until July, 2010, when anthrax was isolated from the carcass of a bison calf that had been killed by predators (Person, 2010a; J. Rankin, MDOL, pers. comm.). Anthrax was detected within wild bison in southern Saskatchewan. That population was reduced by approximately half (G. Vaadeland, pers. comm., 2014). In addition there have been anthrax outbreaks in several Wood Bison herds that also had significant population impacts. A measure utilized to prevent the spread of anthrax in wild bison herds is the monitoring and disposal of affected carcasses, as carcass scavenging may result in environmental contamination (Nishi et al., 2002).

Bluetongue

Bluetongue is an insect-borne, viral disease that primarily affects sheep, but can occasionally affect goats, deer, and antelope and very rarely affect cattle (APHIS, 2010a). Bison are susceptible to the virus, and infection has been observed under field and captive conditions (Dulac et al., 1988). Infection of humans has not been reported (APHIS, 2010a). The virus is noncontagious and cannot be transmitted between species without the presence of the insect carriers, which are various species of *Culicoides* midges (Stelljes, 1999; APHIS, 2010a).

The distribution and prevalence of the virus is dependent upon seasonal conditions and the presence of the insect vectors and susceptible animals. The midges prefer warm, moist conditions, and are most prevalent after periods of warmth and precipitation (APHIS, 2010a). Bluetongue is less common in northern regions (Gates et al., 2010). The virus does not survive outside of the host animal or the insect vector, and is not transmitted through animal carcasses or products (APHIS, 2010a).

The virus may cause mortality within sheep, but mortality rates within the United States have been reported around just 5% (Stelljes, 1999). There is no known treatment for bluetongue, but the prevention of infection can be increased by using a combination of quarantine and movement control, treatment and husbandry practices to control the insect vectors, and zoning to define infected and disease-free regions (APHIS, 2010a). Infection of bison has not been widely reported in North America (Gates et al., 2010). The testing of

several public bison herds has not found seroreactors for the bluetongue virus (Gates et al., 2010). The USFWS found that bison that were located near a recent outbreak of bluetongue in deer did not show signs of infection (Gates et al., 2010).

Bovine Anaplasmosis

Bovine anaplasmosis (anaplasmosis) is a disease caused by *Anaplasma marginale,* which is a rickettsia that parasitizes the red blood cells of host animals (Davidson and Goff, 2001; Gates et al., 2010). There are multiple species of *Anaplasma* within the order Rickettsiales that infect domestic cattle, sheep, goats, and a variety of wild ruminants including deer, elk, and bison (Davidson and Goff, 2001). It is not infectious to humans (Gates et al., 2010). Anaplasmosis survives and reproduces within a host and is transmitted primarily through blood-sucking insects (Gates et al., 2010). The most prevalent spreading of the disease occurs through ticks since the rickettsia can survive and reproduce within the tick (Davidson and Goff, 2001). Transmission from biting insects, including flies and mosquitoes, occurs less frequently because the rickettsia remains viable for only a short period of time on the insect's mouthparts and does not survive and reproduce within the insect (Davidson and Goff, 2001). Transmission has also been reported to occur through vaccination needles or dehorning and castration equipment (Davidson and Goff, 2001).

Most infections of anaplasmosis are subclinical, meaning those infected do not display obvious symptoms. Domestic livestock may have acute, subacute, or chronic infection (Davidson and Goff, 2001). Bison may be more resistant as experimentally infected bison calves demonstrated only mild clinical signs (Zaugg and Kuttler, 1985; Gates et al., 2010). Tests have been developed to identify anaplasmosis within domestic livestock, but serodiagnosis tests have not been as reliable for wildlife, often generating false results. Anaplasmosis has been managed within domestic livestock including domestic bison through vector control, vaccination, and antibiotic therapy (Davidson and Goff, 2001). These management programs are not logistically feasible for wildlife, and have not been implemented since the disease does not tend to compromise the health of wild bison.

Anaplasmosis is a disease of international regulatory concern, and therefore impacts livestock trade between Canada and the north-central and northwestern United States (Gates et al., 2010). Bison are a known host of *A. marginale* anaplasmosis (Gates et al., 2010). Naturally occurring anaplasmosis infection has occurred on the National Bison Range, where 15.7 % of the bison have tested positive (Zaugg and Kuttler, 1985; Gates et al., 2010).

Bovine Brucellosis

In Montana, Bovine brucellosis (brucellosis) is the primary disease of concern that affects the management of bison. Brucellosis is an infectious, contagious disease caused by a bacterium of the genus *Brucella* (Thorne, 2001; MDOL, 2010c). Brucellosis was first detected in wildlife in the early 1900's and was most likely introduced into wildlife populations through contact with infected domestic livestock. The bison herd of YNP is infected with brucellosis, which has large implications on the way the herd is managed. Treanor et al. (2011) note "bison management practices used to prevent brucellosis transmission to local cattle conflicts with the goal of conserving bison and the processes

that sustain them (e.g. migration) (Treanor et al., 2011, p. 1325). Bison programs in other regions outside of the Greater Yellowstone Area (GYA) do not have chronic brucellosis infection, and the majority have been free of brucellosis since their development.

In 2011, new national regulations were developed that change the way brucellosis is managed so that a state no longer loses its brucellosis-free status when infection is detected (APHIS Veterinary Services, 2009; Official Order No. 10-01-D). Since that time, there have been cases of brucellosis in domestic livestock within Montana, but these have been managed on a herd by herd or individual animal basis with a shift from herd depopulation to the development of risk-based affected-herd management plans (APHIS Veterinary Services, 2009).

Brucella has six species, each with their own principal host. Bovine brucellosis is caused by the species *Brucellosis abortus,* whose primary hosts are cattle and bison (Thorne, 2001; Gates et al., 2010). Elk (*Cervus elaphus*) are also susceptible to *Brucellosis abortus*, and appear to contribute to the interspecies transmission in the GYA (Davis et al., 1990; Rhyan et al., 1997; Beja-Pereira et al., 2009; Gates et al., 2010; Anderson et al., 2012). Higgins et al. (2012) reinforce earlier conclusions that elk constitute the most likely reservoir for this pathogen among GYA wildlife. Seroprevalence rates among elk herds in the GYA range from 8% to 60%, while in bison herds, seroprevalence ranges from 11% to 75%" (Higgins, et al., 2012).

A study by Proffitt et al. (2010) found that despite high levels of spatial overlap between elk and bison within YNP the rates of elk exposure to *B. abortus* were similar to rates of exposure in other GYA free-ranging populations not in contact with bison, and lower than rates in elk populations associated with winter elk feeding programs. Proffitt et al. (2010) note that it therefore "appears that the high degree of spatial overlap with bison during the period of transmission risk has little impact on elk exposure to *B. abortus*" (p. 287). DNA genotyping has indicated that there is a relatively high genetic divergence between the *Brucellosis abortus* found in elk and that found in bison, which suggests that the disease is not extensively exchanged between the two species (Beja-Pereira et al., 2009; White et al., 2011a).

Brucellosis is transmittable to humans and causes undulant fever, which is treatable (Thorne, 2001; MDOL, 2010c). The disease is transmitted to humans through consumption of unpasteurized milk or through direct contact with infected animals during birthing, abortion, or in slaughterhouses (MDOL, 2010c). "Infection by *B. abortus* is rarely fatal in humans, but can cause severe, reoccurring, fever-like symptoms. Humans cannot pass the disease to animals or other humans" (White et al., 2011a, pp. 15–16). It is B*rucella suis*, which affects pigs, not *Brucella abortus* that is listed on the Center for Disease Control and Prevention's list of bioterrorism agents and diseases. However, the listing of *Brucella suis* makes it very difficult and expensive to conduct research on all of the Brucella species.

Brucellosis does not appear to be able to replicate outside of a host, but it can survive in certain environments and under certain conditions (Thorne, 2001, Aune et al., 2009; 2012). A study by Aune et al. (2009; 2012) found that Brucella bacteria could persist on fetal

tissues, soil or vegetation for 21-81 days depending on month, temperature, and exposure to sunlight. Soil, vegetation, and tissue at birth or abortion sites of infected bison can remain infectious for up to 43 days in April and 26 days in May (Aune et al., 2009; 2012). Bacteria purposely applied to fetal tissues persisted longer in February then May, but did not survive on tissues beyond the 10th of June regardless of when they were put out (Aune et al, 2012). Scavengers consume most aborted fetuses and, therefore, maintaining a complete assemblage of scavengers enhances the rapid removal of potentially infectious tissues (Aune et al., 2012).

Within cattle and bison, the disease tends to localize in the udder or reproductive organs and perpetuates naturally through growth in the female reproductive tract (Cheville et al., 1998; MDOL, 2010c). The disease is transmitted primarily though oral contact with an infected fetus, calf, or placenta; through contaminated feed or water; or through licking the genitals of an infected female after a birth or abortion (Thorne, 2001; MDOL, 2010c; Gates et al., 2010). The study by Aune et al. (2012) suggests that contact with infected fetal tissues could be a significant risk factor for inter- and intra- species transmission of brucellosis among native ungulates throughout the GYA, as well as between domestic livestock and wildlife species. Studies have indicated that male bison that are infected with brucellosis do not appear to transmit the disease to a female through breeding (Thorne, 2001).

The most obvious indication of infection within a pregnant animal is abortion, birth of weak calves, and vaginal discharge (MDOL, 2010c). More than 90% of infected bison will abort during their first pregnancy; this rate decreases to an abortion rate of 20% after the second pregnancy, and to nearly zero after the third, due to naturally acquired immunity (Davis et al., 1990; Davis et al., 1991; Gates et al., 2010).

There are tests to determine if an animal is infected with brucellosis; however, accurate testing can be difficult to achieve due to false negative cultures, which relate to the difficulties in isolating bacteria from chronically infected animals (Cheville et al., 1998; Gates et al., 2010). Brucellosis may be identified through the detection of antibodies in the blood; however, the presence of antibodies does not imply current living infection and can lead to an overestimation of the true level of infection (Cheville et al., 1998; Gates et al., 2010). “In bison, B. abortus antibodies are long lived (Rhyan et al, 2009); thus, seroprevalance overestimates the level active infection (Roffe et al., 1999) by failing to distinguish between infected and recovered animals (i.e. bison that have cleared the bacteria)” (Treanor, et al., 2011, p. 1325). New tests have been developed that do not look for the antibodies, but for the antigen/antibody complexes (K. Aune, WCS, pers. comm.). It is possible for a cross-reaction to occur in false positive results due to exposure to bacteria that is similar in structure to brucellosis (N. Anderson, FWP, pers. comm.).

Recent studies indicate that infection rates appear to be age dependent. Treanor et al. (2011) concluded that active B. abortus infection in Yellowstone bison is age dependent, allowing infection probabilities to be estimated based on age and quantitative diagnostic tests. The study indicates Yellowstone bison acquire B. abortus infection early in life (0-5

years of age) and typically show elevated antibody levels as they grow older (5+ years of age (Treanor et al., 2011).

Currently there is no treatment for animals that have been infected with brucellosis (MDOL, 2010c). Many bison develop immune responses, but do not become free of the bacteria (Cheville et al., 1998). The MDOL (2010c) encourages the testing, vaccinating, and isolation of replacement stock, separation of domestic livestock from wild herds that are infected, maintenance of clean calving environments, and use of gloves when assisting in calving or abortions to reduce the transmission of brucellosis. There are two vaccines for brucellosis in domestic cattle. Strain RB51, is preferred to Strain 19 and does not have as many adverse effects on cattle as Strain 19. StrainRB51 does not interfere with the accuracy of diagnostic tests as Strain 19 does (Cheville et al., 1998). Strain RB51 is approximately 50% effective in bison (Olsen et al., 2009) and has been shown to induce endometritis, placentitis, and abortion in adult bison, though it is believed that this may be related to the timing and location of the injection (Palmer et al., 1996; N. Anderson, FWP, pers. comm.). Strain RB51 does not appear to have significant adverse effects on bison calves (Roffe et al., 1999), and has been provisionally approved for use in bison, though its safety and efficacy still remain unclear (Gates et al., 2010). Efforts to develop additional vaccines are limited by the resources required by the Center for Disease Control's listing of B*rucella suis*.

Brucellosis Management

Within Montana, the wild bison of YNP are considered to be chronically infected with brucellosis (Cheville et al., 1998), and a number of management actions have been designed to reduce seroprevelance and prevent transmission. Such actions include vaccination, temporal and spatial separation from domestic livestock, distribution management, quarantine, capture, testing, and slaughter. The practice of vaccinating, testing, and slaughter has been successfully used to eliminate brucellosis in the Henry Mountains, Wind Cave National Park, and Elk Island National Park herds (Gates et al., 2010).

A quarantine program for eliminating brucellosis was designed for Wood Bison during the Hook Lake project and was considered successful (Nishi et al., 2002; Gates et al., 2010). In 2005, FWP and the US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) developed a similar Quarantine Feasibility Study (QFS) in order to develop quarantine procedures that would allow YNP bison to be accepted as free of brucellosis. In turn, these bison are suitable for the establishment of new herds or to augment existing populations in order to preserve bison genetics and increase the number of conservation herds. The quarantine protocols and research data gathered at the bison quarantine facilities in Corwin Springs, Montana have established processes and monitoring methods that have yielded bison that are seronegative for brucellosis. Results of the study were published in the March 2014 edition of the Journal of American Veterinary Medical Association.

The first two research groups of YNP bison that completed the QFS protocols are considered by APHIS to be free of brucellosis. In 2009 after phase one of the protocols were

completed, FWP released a request for proposals to identify a location where the 83 research bison could be kept through a 5-year monitoring period. Turner Enterprises' Green Ranch near Gallatin Gateway Montana was selected following completion of an Environmental Assessment (EA). Turner Enterprises assumed management responsibility and cost for the bison in return for 75% of the offspring born under their care. The monitoring period ended in 2014, at which point FWP transferred 139 bison from the Green Ranch to the Fort Peck Reservation following completion of an EA and signing of a Memorandum of Understanding (MOU) with the Tribes. Terms of the 2104 MOU are very similar to those of the 2012 MOU referred to below.

In 2012, the final group of 64 research bison completed their phase one protocols and again FWP released a request for proposals to identify a location for the monitoring period. The selected location was the Fort Peck Reservation following completion of an EA and the signing of a MOU with the Tribes. One of the terms of the MOU is that FWP retains the right to request up to twenty-five percent of the progeny of the QFS bison for future bison conservation on other tribal or public lands, in addition to requirements of access to the bison for the phase two monitoring protocols. A portion of these QFS bison were subsequently transferred to the Fort Belknap Tribes for the remainder of the monitoring period under the same terms as the QFS bison remaining on Fort Peck tribal lands.

As the prevalence and distribution of brucellosis within the United States has been greatly reduced due to effective eradication and testing programs, APHIS developed a strategy that enables a more effective and efficient application of limited resources toward minimizing disease risk (APHIS Veterinary Services, 2009; Official Order No. 10-01-D). In 2011, new regulations were developed to manage brucellosis on a herd-by-herd basis and a state no longer loses brucellosis-free status upon detection of infection in a herd. There has been a shift from herd depopulation to the development of risk-based affected-herd management plans (APHIS Veterinary Services, 2009).

This strategy moves away from a whole state approach and establishes disease management areas that are collaboratively managed by the state and federal government, thus minimizing the burden on individual states (APHIS Veterinary Services, 2009). This design allows for a more effective approach to disease management and minimizes the economic impact on producers (APHIS Veterinary Services, 2009). Under the new strategy the status of the entire state is not affected based on the infection of individual herds (APHIS Veterinary Services, 2009).

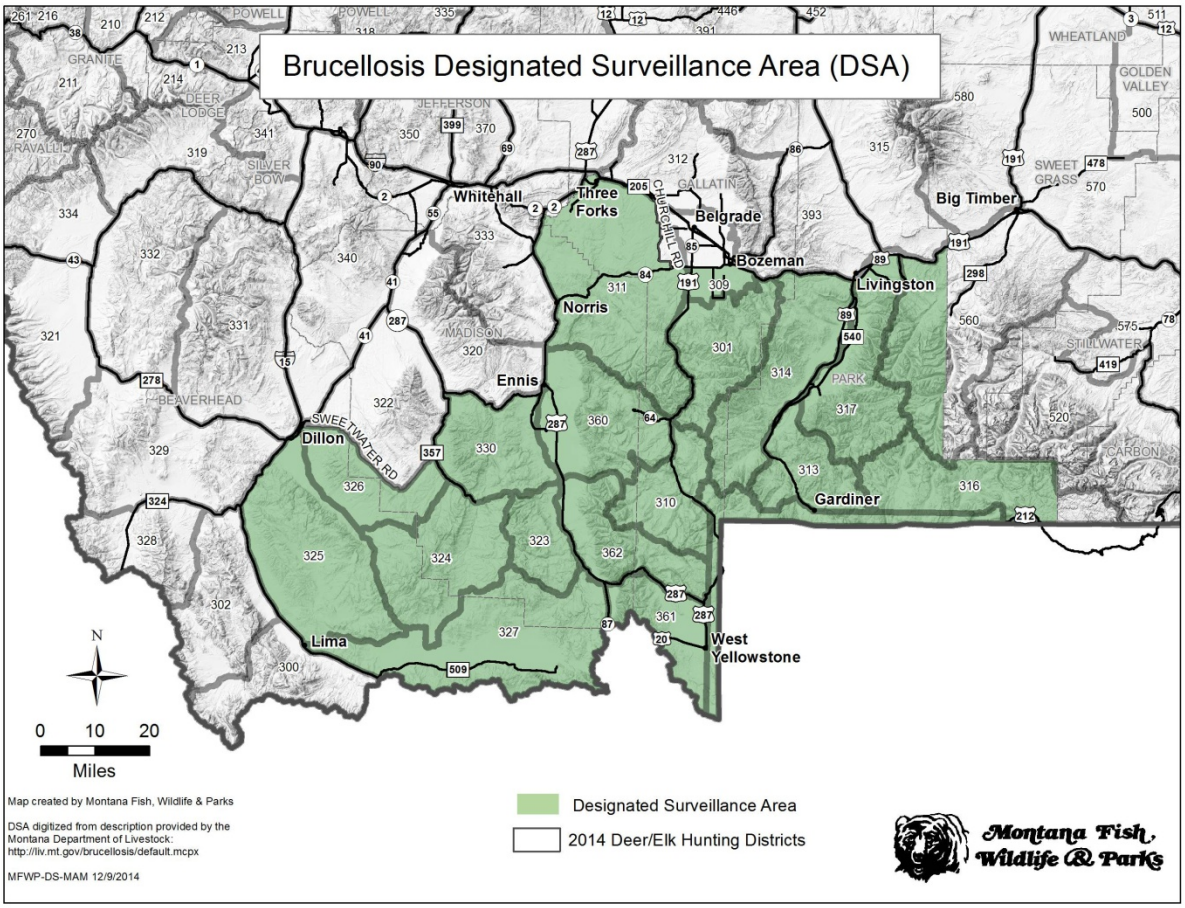

Figure 2: Designated Surveillance Area (DSA) for brucellosis monitoring around Yellowstone National Park.

The new regulations and Official Order No. 10-01-D established a Designated Surveillance Area (DSA) in certain counties in Montana. The Montana Board of Livestock adopted boundary changes in 2011 and 2012 to encompass an area south and southeast of Dillon due to the finding of brucellosis exposed elk within the areas. In 2014, the Montana Board of Livestock approved a boundary change to include an increased area between Norris and Three Forks (Figure 2). The order also outlines the requirements for brucellosis vaccination and testing of domestic livestock within Montana by establishing the surveillance and vaccination requirements for brucellosis. MDOL reimburses directly for testing and for adult vaccination costs (MDOL, 2013). In 2013, 45,131 cattle were tested at a cost of $364,629 and in the first half of 2014, 18,710 cattle were tested at a cost of $163,620. Montana and APHIS have begun operating under the new regulations and despite the discovery of infected domestic herds, the state has not lost its brucellosis-free status.

Bovine Spongiform Encephalopathy

Bovine spongiform encephalopathy (BSE), which is also referred to as "Mad Cow Disease," is one of the transmissible spongiform encephalopathies, which is caused by rogue, misfolded protein agents called prions that are lacking nucleic acids (Prusiner, 1982; Gates et al., 2010). BSE was identified in bison in zoological collections in the British Isles, though there has not been a case of BSE reported in bison in North America (Kirkwood and Cunningham, 1994; Gates et al., 2010). There have also been no reported wildlife cases of BSE in North America.

Research has shown that an animal becomes infected with BSE through the consumption of feed that is derived from infected animals (MDOL, 2010b). In order to prevent BSE in Montana, the MDOL issued an official order in March 2001, which states that "animal protein derived from mammalian tissues shall be prohibited in ruminant feeds in Montana" (Official Order No. 02-01-001).

BSE is a chronic degenerative disease that affects the central nervous system of the infected animal. Though there are tests for BSE, there is not a treatment, and death tends to occur within six months of infection (MDOL, 2010b). The human consumption of BSE-contaminated food causes the new variant Creutzfeldt-Jakob disease, which is fatal in humans (Gates et al., 2010).

Bovine Tuberculosis

Bovine tuberculosis (BTB) is a chronic and progressively debilitating contagious disease caused by a bacterium that is part of the Mycobacterium group (MDOL, 2010e). BTB has the largest range of hosts of the Mycobacterium group with the ability to infect all warm-blooded vertebrates (MDOL, 2010e). Cattle and bison are the primary hosts for BTB, making them susceptible to infection and allowing the bacteria to grow and spread within them under natural conditions (Gates et al., 2010). BTB is zoonotic and therefore can be transmitted from livestock and wildlife to humans (MDOL, 2010e). Human infection is rare, and treatment requires six to nine months of antimicrobial drugs, but the treatment success rate is more than 95% (Gates et al., 2010). BTB replicates and grows within a host, but can only survive outside a host for a few weeks (MDOL, 2010e). The bacteria cannot tolerate prolonged exposure to heat, direct sunlight, or dry conditions, but under cold, dark, and moist conditions it can survive (MDOL, 2010e).

An animal or human becomes infected with BTB primarily though inhalation or ingestion of unpasteurized milk (J. Rankin, MDOL, pers. comm.). Microscopic droplets, or aerosols, containing the BTB bacteria are expelled from the infected animal through exhaling or coughing, and in turn may be inhaled by a susceptible animal or human (MDOL, 2010e). Infection of offspring may occur through ingestion of contaminated milk, and humans may become infected through the consumption of unpasteurized milk from infected cows (MDOL, 2010e). Infection may also occur through communal water sources contaminated with saliva or other discharges from infected animals (MDOL, 2010e). Once the bacterium has entered a new host, it may take many months to develop due to its slow growth rate. It is also possible for the bacteria to remain dormant within a host without causing the disease (MDOL, 2010e).

The signs and symptoms of BTB often do not become apparent until the advanced stages of the disease (MDOL, 2010e). As infection progresses it leads to a generalized stage, which causes weakness, debility, reduction in fertility, and eventually death (Clifton-Hadley et al., 2001; Gates et al., 2010). The immune response that results from a BTB infection allows detection of the disease through tuberculin skin tests, though this is not an effective test for wildlife as it requires a three-day waiting period for the results and may produce false positives that require further testing (MDOL, 2010e; N. Anderson, FWP, pers. comm.). There currently is not an effective vaccine for BTB, however, there is evidence that individual domestic animals can be treated through the long-term use of antibiotics (Gates et al., 2010). This treatment is not practical for wildlife due to the need for long-term containment and the high cost of therapy (Gates et al., 2010).

Current endemic infection within bison has only been documented in and around Wood Buffalo National Park in Canada (Clifton-Hadley et al., 2001; Gates et al., 2010). There have been no reported cases of BTB within bison herds in Montana.

Bovine Viral Diarrhea

Bovine viral diarrhea (BVD) is a disease caused by a virus that is a member of the *Pestivirus* genus (Van Campen et al., 2001). BVD infects a variety of domestic and wild ruminants (Loken, 1995; Van Campen et al., 2001). The virus is very common in cattle in North America, but there are few confirmed cases of pestivirus-caused disease in wild ruminants (Van Campen et al., 2001; Gates et al., 2010). BVD poses no known threat to humans (Gates et al., 2010). The virus is mainly transmitted to wildlife through interactions with domestic livestock, as the principal reservoirs of BVD are persistently infected cattle and sheep (Van Campen et al., 2001; Gates et al., 2010). BVD is transmitted from persistently infected animals to susceptible animals through direct contact, aborted fetuses, fetal membranes, secretions, and shared food or water sources (Van Campen et al., 2001). The factors that influence the persistence of BVD in a population are size and density, herd behavior, the timing of reproduction, and the survivorship of offspring (Van Campen et al., 2001). There is evidence of BVD in bison in the GYA, and positive antibodies were detected in 31% of tested bison within YNP (Williams et al., 1993; Taylor et al., 1997). Pastoret et al. (1988) suggest that wildlife do not play a determinant role in the transmission of BVD to domestic livestock.

Infection within wild ruminants and cattle depends upon the immune status of the animal, the route of transmission, and the virulence of the isolate (Van Campen et al., 2001). Though rare, persistently infected cattle may eventually develop mucosal disease, which results in severe diarrhea, dehydration, fever, loss of appetite, and often, death (Van Campen et al., 2001; World Organization for Animal Health, 2009). There are tests to determine the presence of the antibodies that occur during exposure to BVD, and domestic livestock can be vaccinated (Van Campen et al., 2001). Though there does not appear to be a proven treatment, animals can develop immunity (Van Campen et al., 2010). Maintaining a closed herd and quarantining replacement stock is recommended to reduce the chance of infection. Maintaining a clean environment and preventing contact with biological waste and birthing fluids can also reduce the risk of infection (Van Campen et al., 2001).

Johne's Disease
Johne's disease, or paratuberculosis, is caused by the bacterium *Mycobacterium avium,* subspecies *paratuberculosis,* which occurs worldwide in a variety of wild and domestic ruminants including bison, cattle, and sheep (Buergelt et al., 2000; Williams, 2001; Gates et al., 2010). Johne's disease typically enters a herd when a healthy but, infected animal is introduced. An animal is most susceptible to the disease during the first year of life. Infection occurs when the newborn swallows a small amount of infected manure from the birthing environment or the udder of an infected mother. Infection may also occur while the animal is still in utero or through the milk and colostrum (APHIS, 2010b). The bacterium that causes this disease may survive in the soil or water for over a year, but will not grow and multiply outside the host (APHIS, 2010b). Humans are not at risk of Johne's disease from either livestock or wildlife (Gates et al., 2010).

The clinical signs of the disease rarely present themselves until two or more years after the initial infection. There is no known treatment for Johne's disease, and the disease typically leads to mortality. The best ways to prevent the spread of Johne's disease are the maintenance of a clean birthing environment, the removal of females that test positive from the herd, the removal or culling of offspring born to infected females, implementation of practices to prevent manure contamination of feed, and replacement of stock from low-risk herds (Gates et al., 2010; APHIS, 2010b). There have not been any reports of Johne's disease within conservation herds of bison, though some commercial herds have had cases (Gates et al., 2010).

Malignant Catarrhal Fever (sheep associated)
Malignant catarrhal fever (MCF) is a disease caused by a virus of the genus *Rhadinovirus* (Gates et al., 2010). There have been at least ten MCF viruses recognized worldwide, and five have been linked to disease within sheep, goats, cattle, and pigs (Gates et al., 2010). Within bison, MCF is caused by infection of the ovine herpes virus type two. Ovine herpes virus type two's natural host is domestic sheep, and though domestic sheep carry the virus they do not express the disease (Heuschele and Reid, 2001; Gates et al., 2010). Testing has indicated that the virus is common in the United States in domestic goats (61%) and sheep (53%) (Li et al., 1996; Gates et al., 2010). Non-natural host animals that develop MCF are not considered contagious and may be dead-end hosts (Heuschele and Reid, 2001). MCF infection in bison is highly lethal, with almost 100% mortality within an infected herd (Schultheiss et al., 2001). Studies have shown that bison herds that are not associated with domestic sheep do not show evidence of MCF and there is no evidence that MCF is infectious in humans (Heuschele and Reid, 2001; Gates et al., 2010).

After initial infection, sheep experience periodic reactivation episodes in which they can transmit the virus (Heuschele and Reid, 2001). Inhalation of aerosol droplets and ingestion of food contaminated with the virus through feces, nasal secretions, and tears are the most common modes of transmission (Heuschele and Reid, 2001). Bison most commonly become infected through direct contact with domestic sheep, though there were cases where MCF was reported in bison herds that were located 3 miles from a lamb feedlot (Schultheiss et al., 2001; Gates et al., 2010).

It is possible to test for the presence of infection, though there is currently no vaccine or effective treatment for MCF (Heuschele and Reid, 2001). In order to reduce the spread of MCF from domestic livestock to bison, domestic bison should not be grazed in the same pastures or adjacent to sheep pastures, especially during lambing periods (Heuschele and Reid, 2001; Gates et al., 2010).

2.4 Bison Management

As with all game species a number of factors affect the management of bison as wildlife. Management would differ based on factors such as location, herd size, habitat quality, etc. It is crucial that any management plan allow for responsive and adaptive management strategies that are able to evolve with changing conditions.

2.4.1 Bison/Agriculture Interactions

Based on observations of bison and cattle in other regions, these two can coexist with minimal interaction. Observations of interactions between the two species have shown that they will sometimes graze within close proximity of one another (e.g. Van Vuren, 2001). There are no known reports of bison preventing cattle from utilizing vegetation or water sources nor are there reports of bison goring cattle or attempting to breed domestic cattle.

Since there is overlap between the forage consumed by bison and cattle, it is important to consider existing grazing practices within any discussion of restoring bison. Montana has a long-standing tradition of allowing private citizens to graze domestic livestock on public lands and this practice is important for the economic viability of individual ranchers and communities within the state. Though recognized as a privilege and not an inherent right, the continuation of the practice of private grazing on public lands is essential to many livestock ranches in Montana. The sale of cattle and calves was valued at $1.7 billion in Montana in the 2012 agricultural census (USDA, National Agricultural Statistics Service, 2012). Cattle are found throughout Montana and would need to be considered within the evaluation of any specific restoration site. Based on observations of bison and cattle in other regions, bison and cattle can coexist on the landscape and interaction appears to be minimal.

Other areas have managed bison in the presence of cattle for decades. Bison and cattle have coexisted within the same region of the Henry Mountains in Utah since the 1940s. The cattle there are managed with a traditional fencing system and yet the bison are able to move across the landscape. As the population of bison increased, so did tension with regional landowners and livestock producers. Efforts to mitigate these issues included the creation of the Henry Mountains Bison Committee. This committee, the BLM, Utah Division of Wildlife Resources, conservation organizations, regional livestock producers, and sporting groups have worked together to ensure that grazing continues to be shared by bison and cattle within the area. Over a million dollars has been spent on habitat and water improvement projects to improve resources for both bison and domestic cattle.

Ranchers have reported occasional observations of the wild Sturgeon River Plains Bison herd in the presence of cattle, but they have not had incidents of bison harassing the cattle,

and note that the two species appear to be pretty tolerant of each other. The potential for conflict between horses and bison is low based on experiences in the Yellowstone ecosystem but the potential for conflict does exist.

Bison can be restored while still maintaining domestic "livestock" bison herds. The presence of restoration bison on the landscape would not mean that domestic bison herds would have to be removed. Other states are able to maintain wild bison and domestic bison. There have not been reports from wildlife managers of conflict between wild bison and domestic bison. In Gardner a number of bison are kept in captivity in an area where YNP bison migrate. The wild bison do examine the captive bison, but there have not been issues of the wild bison damaging the fencing. It may be necessary to increase the fence height of the captive bison herds to prevent interaction. Montana already maintains a dual legal status for bison, wild or domestic, based on their ownership. The sale of domestic bison in 2012 was valued at $7.4 million from 66 bison operations.

Bison restoration could be considered in conflict with the agricultural crop industry of Montana. There were over 9.5 million acres of harvested cropland in 2012 in Montana with nearly $2 million of those acres irrigated. The market value of grains, oilseeds, dry beans, and dry peas was $1.7 billion (USDA, National Agricultural Statistics Service, 2012). Crop lands are found throughout Montana and would need to be considered within the evaluation of any specific restoration site.

2.4.2 Fencing

Most of the information pertaining to the effectiveness of fencing related to bison comes from those who are attempting to contain domestic bison and deter their natural instinct to move to better habitat. Fencing is viewed differently when it is recognized as a way to keep domestic livestock contained while allowing wildlife to move across the landscape. For example, if a fence is meant to contain a captive bison herd and the animals are able to jump the fence, then it is ineffective; however, if the purpose is to contain domestic livestock and allow restoration bison to move across the landscape by jumping the fence, then it is considered effective.

When evaluating a fence's ability to contain captive bison, it is important to consider the following factors, as they may enhance or hinder the effectiveness of fencing: 1) Whether or not a fence is constructed and maintained properly will have a large impact on its ability to contain bison; 2) The ability of the herd to access the proper quality and quantity of food and water is essential to maintaining them within fencing, as bison's motivation to breach the fence will increase if more adequate food or other resources are on the other side of the fence; 3) The density of bison can impact the effectiveness of fencing, with effectiveness decreasing as density increases; 4) The age and sex structure of the herd can impact the effectiveness of a fence, as a herd with more bull competition can lead to containment difficulties; 5) Snowpack and snowdrifts can also have an impact on the ability of a fence to contain bison (Gates et al, 2010; C. Knowles, Wildlife Biologist and Bison Rancher, pers. comm.). A final important factor in evaluating the effectiveness of fencing is determining the impact it may have on all other wildlife species in the area.

Bison managers and domestic bison producers prefer different types of fencing, and a variety of types appear to be effective in containing captive bison. Familiarity with electric fencing deters domestic bison from contact and properly constructed and maintained electrified fencing appears to be highly effective in containing captive bison herds (Lee, 1990; Butterfield Sr., 1990; Karhu, 2004; Quitmeyer et al., 2004; Dixon, Manager Snowcrest Ranch, pers. comm.). There is evidence that properly maintained three-wire, four-wire, and five-wire high-tensile electric fences are all effective for containing domestic bison (Lee, 1990; Butterfield Sr., 1990; Karhu, 2004; Quitmeyer et al., 2004; Paige, 2008; Dixon, Snowcrest Ranch, pers. comm.). If three-wire fencing is properly constructed and maintained, it should contain bison, yet be traversable by both adult and juvenile deer, elk, moose, and pronghorn antelope (Karhu, 2004; Quitmeyer et al., 2004; Paige, 2008). Four-wire fencing has not been proven to offer better control of bison, and it can be difficult for elk and moose to traverse (Karhu, 2004). The Snowcrest Ranch recommends a five-wire high-tensile electric fence, which is 48 inches in height with an 18-inch bottom wire (Dixon, Snowcrest Ranch, pers. comm.). However, FWP's *A Landowner's Guide to Wildlife Friendly Fences: How to Build Fence with Wildlife in Mind* (Paige, 2008) strongly cautions against fencing over 42 inches as it can have an adverse impact on other wildlife.

One of the main concerns with high-tensile wire is that it tends to stretch, and therefore does not readily break when an animal becomes entangled. While electric fencing does appear to be more effective than other types of fencing in containing bison, bison handlers have reported that when electric fences short out, bison quickly test the fences and may move through them (C. Knowles, wildlife biologist and bison rancher, pers. comm.).

Barbed wire fencing has also been used to contain domestic bison herds. Some landowners recommend five barbed wires with a height of about 5 feet 6 inches, though others note that a properly maintained three- or four-barbed wire fence will deter wild bison and/or contain domestic bison (Butterfield Sr., 1990; G. Vaadeland, pers. comm.). Barbed wire fencing can be highly problematic for wildlife species, especially if wires are loose or are spaced too closely (Paige, 2008). Many wildlife species, including native ungulates and birds, can become tangled in barbed wire fencing (Paige, 2008).

Woven wire fencing that is 48 inches high with two or three barbed wire strands at the top has also proven successful in containing captive bison (Butterfield Sr., 1990). Yet, woven wire creates a significant barrier for any wildlife species not able to jump or slip through, especially fawns or calves (Paige, 2008). Woven wire becomes a complete barrier when it is topped with barbed wire, especially for fawns, calves, pronghorn, and other animals that are unable to jump such a fence (Paige, 2008). Researchers at Utah State University completed a study of wildlife mortality along more than 600 miles of fence in the rangelands of northeastern Utah and northwestern Colorado and found that woven wire fence topped with a single strand of barbed wire was the most lethal type of fence (Harrington 2005, Harrington and Conover 2006).

2.4.3 Hunting

FWP utilizes hunting as a wildlife management tool, which in turn, generates public interest in the conservation of wildlife. The first Montana bison hunting program was authorized by the 1985 Montana Legislature, but was rescinded by the 1991 Montana Legislature due to negative public reaction to the way the hunt was conducted. In order to ensure all kills were quick and humane and so hunters could successfully harvest bison, all hunters were escorted by a game warden who guided them to the bison. This led to criticisms of "unfair chase" and "slaughter" (McMillion, 2009).

In 2005, the Montana bison hunting program was restored in order to cull bison that migrate from YNP, and increase the interest of the sportsman community in the species and its management. When the Montana legislature decided to bring back the bison hunting season, it stipulated that hunts had to be conducted under the rules of fair chase, i.e., hunters had to be on foot, and FWP officials could not tell hunters the specific location of bison (McMillion, 2009). The 2013 Montana Legislature passed HB 328, which removed the former provision that that FWP could not inform hunters of the physical location of wild bison. Under the revised statute, FWP may inform hunters of the general whereabouts of bison, as they do with other game species. The number of bison that exit the park varies from year to year, and therefore hunter success has varied from 1 to over 300 harvested in a year (Table 1). During the 2014-2015 harvest season, MFWP had over 9,513 applicants for 80 bison tags. Application fees for residents was $10 and $50 for non-residents. Either sex license fees were $125 for residents and $750 for non-residents. The total revenue generated from the applications and license sales totaled nearly $140,000 during the 2014 license year.

Hunters from the CSKT, the Shoshoni-Bannock, the Nez Perce, and the Umatilla tribes are able to hunt bison in regions of Montana based on the off-reservation, tribal treaty hunting rights reserved within their respective treaties. In the spring of 2013, the Crow tribe passed a resolution asserting their tribal treaty hunting rights. The tribe has not yet acted on this assertion. In addition to the five tribes listed above who are exercising their off-reservation hunting rights, Montana statute preserves the limited rights of the Assiniboine and Sioux, Blackfeet, Chippewa Cree, Gros Ventre and Assiniboine, Northern Cheyenne, and Little Shell Band of Chippewa (§ 87-2-731 MCA) to hunt bison.

Hunting is also used as a bison management tool in Alaska, Alberta, Arizona, British Columbia, South Dakota, Utah, and Wyoming. The number and types of licenses/permits that are issued, as well as the format of hunts within each region, changes based on the current bison population and management objectives. Licenses range from $50 to $5,400. Hunter success rates vary but range from 75% to over 90%.

Year	Applications	Successful Drawing Applicants	Bison Harvested (total or state/tribal hunter)
2004-05	8,373	10*	0*
2005-06	6,178	24	40/6
2006-07	6,210	74	31/26
2007-08	4,402	38	63/103
2008-09	3,079	36	1/0
2009-10	10,363	36	1/0
2010-11	7,754	34	22/172
2011-12	8,079	34	11/18
2012-13	7,834	34	37/213
2013-14	10,132	44	36/291
2014-15	9,513	72	42/172
*The current hunt did not begin until 2005. The successful 2004 applicants were given a 2005 license; therefore there were 34 licenses issued in 2005.			

Table 1. Number of applications and successful applicants for bison hunting tags in Montana. Data provided by N. Whitney, FWP. Harvest information provided by A. Jones, FWP.

In many locations, bison are a highly sought after hunting opportunity. Bison have adapted to hunting pressure in a manner similar to other big game species and can provide for a challenging hunting experience. Due to the limited number of 'wild' bison, many still hold the common misperception that bison are less wary than other wildlife and therefore, do not make for a challenging hunt. This is because most people are exposed to bison that are in domestic herds or in areas where hunting is prohibited, such as in a national park. Regions that maintain wild populations of hunted bison report that bison quickly become very wary of humans, resulting in a hunting experience similar to other big game species. Game managers in Utah report that hunting has resulted in bison with a strong tendency to flee at the sound of a stopping vehicle or the smell of approaching hikers. A biologist for the Kluane region of the Yukon, notes "hunting pressure is changing the behavior of these animals. They're moving away from places where people commonly saw bison the last few years in late winter and they're clearly avoiding people, going to places that are difficult to go to" (CBC News, 2001).

Managers use hunting as a tool to manage population size, distribution, increase landowner tolerance, develop public support, and monitor herd health. The Alaska Department of Game and Fish uses hunting as the main tool for managing the size and composition of the Delta Basin herd. Within Utah parts of the region where bison reside have significant physical barriers to bison movement, but it is probable that population management has had the greatest effect on the minimal dispersal observed. Public hunting of the Henry Mountains bison has been an essential part of the management program. Regional

managers adjust the annual number of permits in order to reduce or decrease the herd size based on regional conditions. The key is maintaining sportsmen access to bison. In Arizona bison have learned to move into Grand Canyon National Park to avoid sportsmen, which has led to an increase in the herd size.

The management plan for the Book Cliffs herd in Utah calls for public hunting to be the principle population management tool for both the tribal and public herds (Utah Division of Wildlife Resources, 2007a). The Ute tribe manages the population though the issuance of hunting permits, and has increased the number of permits in an attempt to reduce the size of the herd. The tribe is also exploring the potential to sell some of the bison to other programs or tribes to further control population growth (K. Corts, pers. comm.).

A public culling of corralled bison was used at one time to manage bison on the Raymond Ranch in Arizona (Bison Management Team, 2002). The practice was modified in 1972 in response to public demand for a fair chase hunt. The wildlife area manager now guides hunters to minimize herd disturbance and to help identify the target age and sex class (Bison Management Team, 2002; A. Zufelt, pers. comm.). The number of hunters is dependent on the current demographics and population objectives for the herd.

The plan established for bison in Grand Teton National Park and the National Elk Refuge allows for public hunting in attempts to maintain the herd within population objective (USDI, 2007). The plan also allows for the annual ceremonial taking of approximately five bison by Native American tribes associated with the region (USDI, 2007). The current attempt to reduce the number of bison through hunting, has been hindered by the fact that the bison tend to stay in Grand Teton National Park where they are safe from hunting. Wyoming Game and Fish has developed an 'on-again-off-again' hunting season to move bison off of the National Elk Refuge to national forest lands where hunters can access the animals.

2.4.4 Native American Hunting Rights

Many of the tribes who were native to Montana and surrounding regions entered into treaties with the U.S. government that preserved their right to continue to hunt on land outside of their respective reservations. Due to subsequent treaties and treaty disputes, many of these rights are still being assessed. Based on how the different treaties were written some of the tribes view the majority of Montana as aboriginal hunting land to which they have a right to hunt.

There is growing pressure from tribal interests, both inside and outside of Montana, to restore bison to public lands in order to honor tribal treaty rights. In 2012, the Montana Wyoming Tribal Leaders Council passed a resolution that called for the State of Montana to recognize the trust responsibility and treaty obligations to American Indian Nations in providing for viable populations of migratory buffalo in their native habitat. The resolution states that "for too long, politics has been used to trump Tribal Treaty Rights, cultural survival, Tribal sovereignty and trust responsibility" (MT WY Tribal Leaders Council, 2012, p. 1). The resolution notes, "by severely limiting wild buffalo abundance and distribution

on public trust lands, the state of Montana has abdicated its trust responsibility to ensure populations of indigenous species persist for future generations in perpetuity" (MT WY Tribal Leaders Council, 2012, p. 1). The resolution resolves that "the State of Montana should recognize that trust responsibility and Treaty obligations to American Indian Nations in providing for viable populations of migratory buffalo in their native habitat" (MT WY Tribal Leaders Council, 2012, p. 2).

The Montana Wyoming Tribal Leaders Council passed a second related resolution in March of 2013. This resolution continued to call for the State of Montana and Federal agencies to "recognize and honor it's trust responsibility and treaty obligations to American Indian Nations in providing for viable populations of migratory buffalo in the wildlife species' native habitat" (MT WY Tribal Leaders Council, 2013, p. 1). The resolution notes that "the American bison or buffalo is inseparable from the identities, traditions, cultures, beliefs, and religious practices of American Indians and an indigenous way of life" (MT WY Tribal Leaders Council, 2013, p. 1). It also notes that "the State of Montana's assertion of jurisdiction over migratory bison creates a reciprocal responsibility to legally consult and cooperate with American Indian Nations to preserve the wild species for future generations in perpetuity" (MT WY Tribal Leaders Council, 2013, p. 2). The resolution notes that "by severely limiting wild buffalo abundance and distribution on public trust and Treaty lands, the state of Montana and the U.S. Department of the Interior, Yellowstone National Park, U.S. Department of Agriculture, U.S Forest Service is violating its trust responsibility to ensure populations of indigenous species persist for future generations in perpetuity" (MT WY Tribal Leaders Council, 2013, p. 3).

The resolution resolves that "the state of Montana designate year-round habitat for migratory buffalo in collaboration with the U.S Forest Service and American Indian Nations so affected to further the land agency's goal of providing habitat for viable populations of all indigenous wildlife species and for increasing populations of big game animals" (MT WY Tribal Leaders Council, 2013, p. 4). It further resolves that "the state of Montana and the United States must recognize and honor it's trust responsibility and Treaty obligations to American Indian Nations in providing for viable populations of migratory buffalo in the wildlife species native habitat" (MT WY Tribal Leaders Council, 2013, p. 4).

2.4.5 Public Safety

Bison, similar to other large herbivores, including moose and elk, pose small, but manageable risks of personal injury (Nelson, 1965; Fortin and Andruskiw, 2003; Taylor and Knight, 2003; Gates et al., 2010). The level of risk is often dependent on the type of management program that is in place. The manner in which bison respond to humans depends on factors such as the level of habituation to humans, hunting pressure, and management practices. Bison that are habituated to humans often exhibit a mild-mannered domestic cow–like appearance. This is particularly true in national parks like Yellowstone, in which bison are protected. The differences between the behavior of animals inhabiting protected areas and those outside protected areas illustrates how human behavior can modify wildlife behavior. While many species typically avoid close contact with humans in non-protected areas, those same species may ignore nearby humans or be attracted to

humans in protected areas such as a park. Protected area wildlife that exhibit habituated or conditioned behavior toward humans often do so because human visitors exhibit habituated or conditioned behavior toward wildlife. (Zinn et al., 2008). The difference between the behavior of bison in areas with hunting programs and protected areas is a result of their experience with humans over time.

Bison programs in other places have only rare reports of human injury and the circumstances where injuries have been reported are typically unique. There is some personal safety risk for herd managers that are handling animals in confined situations or treating bison like domestic animals, however these risks have been minimal in other areas. Some risk to personal safety also exists for landowners, motorists or recreationists. As discussed in the hunting section (2.4.3), bison that are hunted often flee from vehicles or hikers.

2.4.6 Bison-Vehicle Collisions

Most drivers in Montana are aware of the potential for wildlife collisions due to the large variety of wildlife and domestic livestock that may be present on roadways. The Montana Department of Transportation marks regions of increased potential for wildlife collisions with warning signs along roadways. Data on the potential for bison-vehicle collisions and frequency of bison encountered on roadways is limited due to the lack of wild herds in the United States. Many mitigations such as wildlife underpasses, fencing, and signs are already in place through the cooperative work of agencies, nongovernmental organizations, and citizens to reduce conflicts of wildlife on roadways around the state. As with all wildlife, there is the potential that bison may enter roadways.

The primary regions of Montana where wild bison are found and where there have been reports of bison-vehicle collisions are the areas north and west of YNP. The highways near West Yellowstone transect highly used bison habitats and cut directly through the bison's winter migratory path creating a high level of bison cross-traffic. Based on Montana Department of Transportation's data on crashes involving bison, the average number of bison collisions on US 191 between 1999 and 2009 was approximately 1.7 per year. The majority of these crashes occurred in the evening or early morning hours. In 2010, there was one collision that occurred with a domestic bison. During the following four years, the number of bison-vehicle incidents was five, three, zero, and two respectively. In comparison, the number of incidents in the Gardiner Basin along US Highway 89 for 2011-2014 was two, zero, zero, and two respectively. All of the 2013 and 2014 incidents resulted in property damage but no human injury.

With more than three million annual visitors to Yellowstone National Park, most arriving during the concentrated summer vacation season and using limited roadways, there is a large potential for collisions with wildlife. The park compiles data on the number of bison killed on roadways based on reported carcasses. The number of bison killed between 2000 and 2009 from vehicle collisions varied yearly from a high of 28 bison killed in 2002 to 9 bison in both 2000 and 2008, with an annual average of 16 bison killed between 2000 and 2009. During 2010, there were 28 reports of bison-vehicle collisions with no human

injuries. In 2011 there were 22 reported bison-vehicle collisions with three human injuries. In 2012, there were 13 bison killed by vehicle collisions. For comparison, there were 642 total reported motor vehicle accidents in the park during 2010 and 549 reported in 2011.

Park personnel feel that excessive vehicle speed increases the risk of collisions with bison, as does the time of day. The YNP Division of Law Enforcement notes that there have been no reported human fatalities from accidents involving bison within the park, based on accident reports from 2008 to 2012.

The British Columbia Conservation Foundation's Wildlife Collision Prevention Program (WCPP) examines bison-vehicle collisions with Wood Bison. The WCPP identifies some of the reasons why Wood Bison use roadways in northwestern Canada. A few of the reasons the animals are attracted to the roadways that were noted include: 1) plowed roads can provide easier travel routes than forested locations, especially during deep snow; 2) highways and right of ways are often windy, which relieves some irritation from biting insects; 3) vegetation along the side of the road is accessible throughout the year; and 4) the disturbed sites on roads provide good establishment of palatable vegetation (British Columbia Conservation Foundation, 2010). The WCPP indicates that traffic factors influencing the number of bison-vehicle collisions include increased traffic volume, an increased number of industrial vehicles, and long straight stretches that allow drivers to travel at speeds well over the posted limits (British Columbia Conservation Foundation, 2010). The WCPP program recommends the enforced reduction of speed limits, especially during the evening, as an effective way to reduce bison-vehicle collisions.

The factors that contribute to bison-vehicle collisions include: 1) the fact that bison are a herd animal; 2) the lowered position in which bison typically hold their head reduces the reflectivity of their eyes, thereby decreasing visibility at night; and 3) bison have different reactions based on their perception of a threat. Seasonal factors such as the rut or the presence of calves may alter the potential of bison-vehicle collisions (British Columbia Conservation Foundation, 2010). The WCPP has found that low and changing light at dawn, dusk, and night can increase the risk of bison-vehicle collisions for a number of reasons including the fact that bison may be more active during periods of low light; that bison have dark coats; and that during periods of snowfall the snow can accumulate on the backs of bison, reducing the contrast between the bison and the ground (British Columbia Conservation Foundation, 2010).

Another important factor in the probability of bison-vehicle collisions is based on whether the roadway transects highly used habitat, as it does outside of West Yellowstone. A report compiled by the Western Transportation Institute noted, US 191 directly cuts through the bison migratory pathway outside of West Yellowstone creating a high level of bison cross-traffic (Dupree and DiMambro, 2010).

The WCPP recommends a number of ways that drivers can reduce the risk of bison-vehicle collisions. These practices include paying attention to road signs indicating the potential presence of bison, maintaining the posted speed, reducing speed at night, remaining more

vigilant, and practicing defensive driving while traveling through regions where bison have been observed.

2.5 Legal Classifications of Bison

The state of Montana's legal classification of bison is based on whether they are found on commercial farms, in private conservation herds, or in the wild. The two classifications given to bison in Montana are "domestic livestock" or "game animal" although bison are often referred to as wildlife or simply wild bison. Bison that are wild and held in the public trust are classified as a game species in Montana. "Game animal means deer, elk, moose, antelope, caribou, mountain sheep, mountain goat, mountain lion, bear, and wild buffalo" (§87-2-101(6) MCA). "Wild buffalo' means buffalo or bison that have not been reduced to captivity" (§87-2-101(16)MCA). FWP is charged with supervising "all the wildlife, fish, game and non-game birds, waterfowl, and the game and fur-bearing animals of the state . . ." (§87-1-201 MCA). In addition, FWP "shall enforce all the laws of the state regarding the protection, preservation, management, and propagation of fish, game, fur-bearing animals, and game and non-game birds within the state" (§87-1-201(2) MCA). Domestic livestock may include bison that have been reduced to captivity and are privately owned under the authority of MDOL under the laws at Title 81.

In 1995, concern over the potential for the spread of disease from wild bison to domestic cattle led to the enactment of a statute that further classified wild bison as a species in need of management under the authority of FWP and as a species in need of disease control under the authority of MDOL (see §87-1-216 MCA). The statute designates "publicly owned wild buffalo or bison originating from Yellowstone National Park as a species requiring disease control" and "designated other wild buffalo or bison as a species in need of management." Currently all wild bison within Montana originate from YNP; therefore management authority for wild bison is shared between FWP and MDOL.

Statute §87-1-216 MCA gives FWP responsibility for the management, "including but not limited to public hunting, of wild buffalo or bison in this state that have not been exposed to or infected with a dangerous or contagious disease but may threaten persons or property". The section further requires FWP to consult and coordinate with MDOL in implementing these management programs "to the extent necessary to ensure that wild buffalo or bison remain disease-free" (§87-1-216 MCA). It also gives FWP the authority to "adopt rules with regard to wild buffalo or bison that have not been exposed to or infected with a contagious disease but are in need of management because of potential damage to persons or property" ((§87-1-216 MCA). The statute was amended in 2011 to require that FWP develop a management plan "before wild buffalo or bison may be released or transplanted onto private or public land" (§87-1-216 MCA). This amendment also requires that "animal containment measures that ensure that any animal transplanted or released on private or public land will be contained in designated areas".

The management of wild bison for disease control gives MDOL the authority to take certain action (§81-2-120(1) MCA). Whenever a publicly owned wild buffalo or bison from a herd that is infected with a dangerous disease enters the state of Montana on public or private

land and the disease may spread to persons or livestock or whenever the presence of wild buffalo or bison may jeopardize Montana's compliance with other state-administered or federally administered livestock disease control programs MDOL may physically remove the live bison by the "safest and most expeditious means from within the state boundaries, including but not limited to hazing and aversion tactics or capture, transportation, quarantine, or delivery to a department-approved slaughterhouse"; the live bison may be "destroyed by the use of firearms"; the live bison "may be taken through limited public hunts when authorized by the state veterinarian and the department"; or the live bison "may be captured, tested, quarantined, and vaccinated" (§81-2-120 (1)(a)–(1)(d)MCA). If MDOL implements the capture, test, quarantine, and vaccinate method, it may certify the wild bison as brucellosis free and then sell or transfer the bison to qualified tribal entities in a "manner that does not jeopardize compliance with a state-administered or federally administered livestock disease control program" (§81-2-120(1)(d)(ii)MCA). "The department (MDOL) may adopt rules consistent with this section governing tribal participation in the program or enter into cooperative agreements with tribal organizations for the purpose of carrying out the disease control program" (§81-2-120(1)(d)(ii) MCA).

Additional Montana Statutes that Pertain to Bison

Public hunting is used as a management tool by FWP to manage the populations of game species and is just one of the tools allowed in the management of bison as a species in need of disease control (§87-2-730 MCA). While FWP has been the agency that regulates hunting, a 2003 statute created a special wild buffalo license whereby "the public hunting of wild buffalo or bison that have been designated as a species in need of disease control is permitted only when authorized by the department of livestock" (§87-2-730(1) MCA). This statute required that FWP adopt rules in cooperation with MDOL and the state veterinarian for the implementation of bison hunts. The hunt must be a "fair chase" hunt, which requires that "hunting be conducted on foot and away from public roads and that there be no designation of specific wild buffalo or bison to be hunted" (§87-2-730(3)(d) MCA).

A person convicted of illegally "taking, killing, possessing, or transporting" wild buffalo "or any part of these animals shall be fined an amount of not less than $500 or more than $2,000, be imprisoned in the county detention center for not more than six months, or both" (§87-1-102(2)(a) MCA). Additionally that individual "shall forfeit any current hunting, fishing, recreational use, or trapping license issued by this state and the privilege to hunt, fish, or trap in this state for 30 months from the date of conviction or forfeiture unless the court imposes a longer forfeiture period" (§87-1-102(2)(a) MCA). The penalties increase if the individual is convicted of repeated offenses.

At the same time as the 1995 reclassification of wild bison as a species in need of management and a species in need of disease control, a statute was adopted that allows a private property owner to kill a wild bison that is "suspected of carrying disease and that is present on the landowner's private property and is potentially associating with or otherwise threatening the landowner's livestock" (§81-2-121(1)(a) MCA). The landowner must first notify or attempt to notify MDOL "in order to allow as much time as reasonable for the department to first take or remove the publicly owned wild buffalo or bison that is

on the landowner's property" (§81-2-121 MCA). The landowner must also "make a good faith effort to notify the department that a taking has occurred and to retain all parts for disposal by the department" (§81-2-121 MCA). The landowner must not "intentionally provide supplemental feed to game animals in a manner that results in artificial concentration of game animals that may potentially contribute to the transmission of disease" (§81-2-121 MCA). If a person is found guilty of providing supplemental feed to game animals as outlined above, they are "guilty of a misdemeanor" and are subject to additional penalties (§81-2-121 MCA).

An act was passed in 2011 that granted MDOL the authority to establish a permit and inspection system for the transportation of domestic bison into and out of counties and into and out of the state for the purposes of tracking animal movements and collecting per capita assessments (§81-1-101 MCA).

2.6 Tribal and Privately Owned Bison in Montana

2.6.1 Tribal Involvement in Bison

In order to facilitate and coordinate the return of bison to tribal reservations, the InterTribal Bison Cooperative, which is now InterTribal Buffalo Council (ITBC), was formed in 1990 (ITBC, 2011). The goal of ITBC is "re-establishing buffalo herds on Indians lands in a manner that promotes cultural enhancement, spiritual revitalization, ecological restoration, and economic development" (ITBC, 2011). As of 2011, ITBC has a membership of 57 tribes and maintains a collective herd of over 15,000 bison (ITBC, 2011). The manner in which the individual herds are managed varies. Some tribes maintain their bison with limited management, while others have more strictly managed herds.

Tribal herds are managed on six of the seven Native American reservations in Montana. As of 2010, there were approximately 2,340 tribal herd bison, including the 400 bison on the NBR, which is co-managed by the CSKT of the Flathead Reservation and the USFWS. The majority of the tribes have expressed interest in expanding their herds if feasible, and many offer limited bison hunting opportunities. Some of the tribes are also in the process of exploring the potential to create separate cultural herds, which would be managed for different purposes and values than commercial herds.

There was a tribal herd on the Flathead Reservation separate from the NBR herd in the past and there is the possibility that one may be reestablished in the future. There are three known larger private herds on the reservation, which vary between 200 and 300 head of bison. In addition, many individuals on the reservation occasionally have a few domestic bison.

The largest of the tribal herds is on the Crow Reservation. As of 2014, the tribal herd has 1,600-1,800 bison and is managed within natural barriers on approximately 30,000 acres, with additional access to 120,000 acres in the mountains. There are plans to expand the herd, as a result of an increase in available acreage. Hunting tags are occasionally issued to the general public as a population management tool. There are no additional privately owned herds remaining on the reservation.

Adjacent to the Crow Reservation is the Northern Cheyenne Reservation. As of 2014, the Northern Cheyenne tribe maintained a tribal herd of approximately 150 head of bison, with plans to expand in the future. Although there is a pasture for the bison, it is small, and the herd tends to be free-roaming on the reservation. Special tags are occasionally issued to tribal members for hunting. There are no additional privately owned herds on the reservation.

As of 2014, the Assiniboine and Sioux (Nakota, Lakota, and Dakota) tribes of the Fort Peck Reservation managed a tribal herd that consisted of approximately 120 bison (post hunting season), which are contained on approximately 9,000 acres. There is a hunting program that is open to tribal and non-tribal members. Bison from the Quarantine Feasibility Study (QFS) have been transferred to the Tribe and as of late 2014 there were 183 bison in this herd. These bison are managed for cultural purposes and separate from the tribe's commercial herd. There are two additional privately owned herds on the reservation, one with approximately 100 bison, and the second with around 50 bison.

The Gros Ventre and Assiniboine tribes of the Fort Belknap Reservation manage a herd of around 600 bison in an enclosure that is approximately 22,000 acres as of June 2014. There are some limited hunting opportunities available to tribal members and the general public, mainly to cull older bulls. For the 2010-2011 season five tags were issued at a price of $2,000 each for a four- to six-year-old bull, and approximately five tags were issued at a cost of $3,000 each for a seven-year-old or older trophy bull. Thirty two of the QFS bison that were initially transferred to Fort Peck were transferred to Fort Belknap, where they are managed separately from the commercial herd. This herd had grown to 43 bison as of late 2014. There are no additional privately owned herds on the Fort Belknap Reservation.

The Blackfeet tribe manages a herd that consists of 120 mature bison and 30 calves as of June 2013. The bison are managed on 1,400 acres in the summer and moved to a 9,000-acre ranch in the winter. The tribe hopes to expand the herd in the future, and currently sells a limited number of hunting tags. There are two privately owned herds on the reservation. The first is made up of about 10 bison, and the second is a newly established production herd of approximately 600 bison.

2.6.2 Private Herds

Bison can be kept as livestock throughout the United States, and today domestic bison in private herds account for over 93% of the bison in North America (Gates et al., 2010). Gates et al. (2010) estimates that within the United States and Canada there are 400,000 privately owned bison on approximately 6,400 farms. Private herds, in which bison are managed as livestock, account for the majority of bison in Montana. The National Bison Association reported in 2012 that Montana had 80 bison farms with 14,671 bison. According to the February 2013 Department of Revenue per capita head count, there were 9,995 reported bison over the age of nine months in Montana, which generated $54,972 in per capita fees for Montana (S. Merritt, MDOL, pers. comm.).

While the efforts of early bison ranchers may have been to conserve the Plains Bison, modern bison ranching is now driven primarily by commercial interests. The management of bison as livestock has led to cattle gene introgression and the domestication of private herds. As Isenberg (2000) notes, domestication is not confinement or habituation to humans, but is instead "selective breeding: humans deciding which individuals will produce the next generation, and choosing them to produce a next generation that will better serve human goals" (p. 198). In order to create more manageable and profitable bison herds, private ranchers selectively breed for desired traits. Ranchers selectively breed for traits that include docility, growth performance, conformation, and reduced agility (Isenberg, 2000; Gates et al., 2010). The artificial selection of preferred traits alters the natural genetic variation of the herd. The large number of domesticated bison, which are found throughout the United States, may reduce the public's perception of the need for bison conservation (Freese et al., 2007), yet domesticated bison have been altered morphologically, physiologically, and behaviorally.

2.7 Social Value of Bison

The symbolic value that bison hold is important to some in Montana, however bison restoration is complicated by the concerns of agricultural and private landowner interests. There are concerns that bison restoration could impact current land uses or that bison could transmit diseases to livestock. There is also the concern that bison could have negative economic impacts or reduce public access to some lands. However, bison restoration also presents opportunities for restoring some of the ecological role bison once played on the prairie, as well as for increasing tourism and hunting opportunities.

2.7.1 Social Value/Perception of Bison Restoration in Montana

The restoration of a bison herd somewhere in Montana could contribute to the wildlife legacy that many Montanans have taken pride in for generations. Montana has worked for decades to restore nearly all the big game and carnivore species, to include mountain goats, elk, wolves and grizzly bears. Bison restoration has been ignored in large part due to the complicated situation around Yellowstone National Park and disease transmission concerns of the livestock industry. Montana statute does call for the conservation and restoration of native species across the state.

In 2014, the Montana Wildlife Federation passed a resolution in support of bison restoration in Montana to include specifying a restoration herd goal of 1,000 animals. The Montana Chapter of The Wildlife Society signed a position statement in 2000 in support of maintaining 'wild' bison and establishing additional herds in Montana where it is ecologically, economically, and socially acceptable.

A public survey commissioned by the National Wildlife Federation (NWF) and Wildlife Conservation Society in 2012 found 68% of the 400 likely voters surveyed support bison restoration in Montana. The survey was conducted in June of 2012 by Public Opinion Strategies, a national market research company and had a margin error of (+ or -) 4.9%. The survey found support for bison restoration remains consistent in response to general and specific questions on the issue. Sixty-nine percent of respondents voiced support for

building a new herd of wild bison on public land in and around the 1.1 million acre Charles M. Russell National Wildlife Refuge (CMR). This survey closely tracks a similar poll conducted by Moore Information, Inc. in February of 2011 that found 70% of Montanans support bison restoration.

The NWF has two specific campaigns underway to restore bison to the CMR and the tribal lands of northeast Montana. According to the NWF, this work presents a unique partnership opportunity to unite sportsmen, conservationists, and state and federal wildlife agencies to return an iconic species to their native habitat. In 1997, the NWF signed a memorandum of understanding with the Intertribal Bison Cooperative to advocate for the return of wild bison to Tribal lands. In 2014, NWF was signatory to a letter in support of FWP restoring bison in Montana along with the following organizations; Montana Wildlife Federation, Hellgate Hunters and Anglers, Gallatin Wildlife Association, Anaconda Sportsmen, Laurel Rod and Gun Club, Helena Hunters and Anglers. Later in 2014, nearly 40 scientists submitted a letter to Montana Governor Bullock supporting bison restoration. There are many other examples of organizations that have publicly proclaimed their support of bison restoration as evidenced by position statements found on their web pages or brochures. Editorials regarding bison restoration are common and include those generally in support of bison restoration somewhere in the state, and others more specific to potential sites in Montana.

Another public survey commissioned by Defenders of Wildlife that polled 500 Montana voters was published in January 2015, showing 76% of those surveyed supported FWP 'restoring wild bison on some of Montana's public lands.' Seventy-eight percent supported 'efforts of tribes to restore wild bison populations on tribal lands' and 67% supported 'efforts to relocate disease-free bison from Yellowstone to start new herds in other parts of Montana.'

In 2014, the Department of Interior (DOI) released a report entitled "Looking Forward" prepared by the DOI Bison Leadership Team and Working Group. The report is an evaluation of existing DOI bison resources crucial to the long-term conservation of the species, and a look at lands that could accommodate the establishment of bison herds in the future. CMR lands are mentioned as DOI property that could be suitable for bison restoration but the report points out that formal planning efforts must be led by the state of Montana.

At the same time these polls, letters and reports have shown *support* for bison restoration, other polls, letters and reports have been submitted to FWP and the Governor's office in *opposition* to bison restoration. There have been locally organized petitions generally against bison restoration or petitions suggesting where bison should be translocated within Montana. One recent such petition hosted on 'change.org' in 2014 supported bison restoration on tribal lands only.

A number of polls or petitions have shown support for restoration of bison on tribal lands. One hundred fifty-five people signed a petition organized by a Hinsdale, MT resident in 2014 supporting full tribal ownership of quarantine bison by the Fort Peck and Fort

Belknap Indian reservations. A recent survey of residents within the Montana area of the Iinnii Initiative (Blackfeet Reservation) showed 74% of survey participants strongly agreed that bison are especially important to Blackfeet people and are an important symbol of Blackfeet history and culture. Seventy percent strongly supported the Blackfeet tribe partnering with neighboring federal, state or provincial land managers to create more bison habitat. Fifty-seven percent strongly supported restoring bison populations somewhere in Blackfeet Country.

A number of recent local government actions to garner more control over wildlife management or management of specific lands further reflect concerns over bison restoration. Some county commissions in Montana have passed ordinances stating all bison within the county are to be classified and managed as livestock. Other counties have passed zoning laws that deem all bison within the county "livestock", restricted to zoned agricultural lands. Still others have passed ordinances to prevent any bison translocation into their counties by FWP or the USFWS without prior county commission approval. Legislation in 2011 and 2013 proposed to do this same thing but both bills were vetoed by the Governor.

The Montana Association of Counties (MACo) passed policies relative to bison to include the following: 1) MACo supports the designation of bison introduced into areas of the state not currently populated by bison as domestic livestock to be managed by the Montana Department of Livestock, and 2) MACo supports requiring regulation of bison by the Montana Department of Livestock to cross county lines. A grazing policy of MACo deals with use of the CMR specifically; the policy "supports livestock grazing on the CMR at levels that sustain economically sound livestock operations and maintains the ecological health of the resource" (2014 MACo Policy Booklet).

The Montana Association of Conservation Districts (MACD) passed Resolution 13-03 in November, 2013 that states the "Montana Association of Conservation Districts stands opposed to free roaming wild buffalo or bison." The resolution further resolves the MACD to: 1) amend Montana Law to prohibit the establishment of any free roaming wild buffalo or bison within the state of Montana; 2) amend Montana Law to clearly define that any bison or buffalo that has been captive, corralled, fenced in, or transported is no longer considered free roaming and/or wild; 3) amend Montana Law to clearly state that bison or buffalo that are not kept in the confines of those wishing to house them will be defined as domestic livestock and subject to Montana laws.

A number of agricultural organizations have publicly opposed any idea of 'free-roaming' bison and numerous anti-bison editorials, have been published in local newspapers by organizations or individuals since the 2012 public scoping meetings. There are many other examples of organizations that have publicly proclaimed opposition bison restoration as evidenced by position statements found on their web pages or brochures.

Rough estimates from the FWP Block Management Access program indicate six landowners (10% of all landowners who dropped out) in 2012 and 14 landowners (21% of all who dropped out) in 2013 claimed to have dropped out due to concerns over FWPs

management of bison. In many of these cases, bison were just one of the reasons cited for dropping out of the program.

2.7.2 Tribal Cultural Values of Bison

Though widely absent from the plains, wild bison still hold an important place in the cultures and spiritual lives of many modern native tribes. In addition to the cultural and spiritual importance of bison there is also an initiative to improve tribal health by returning to the traditional diet of bison meat. Many native tribes have restored domestic bison herds for meat production. There has also been pressure from many tribes for Montana or the federal government to restore wild bison in order to honor tribal treaty hunting rights. Many of the tribes who were native to Montana and surrounding regions entered into treaties with the U.S. government that preserved their right to continue to hunt bison outside of their respective reservations.

Efforts of the Montana Wyoming Tribal Leaders Council and Inter Tribal Buffalo Council to restore bison across the range of the bison highlight Native American interest in bison for cultural and historical purposes (see sections 2.4.4 and 2.6.1 of this document for more information).

In Montana the tribes of the Blackfeet, Fort Peck, Fort Belknap, Crow, and Northern Cheyenne Reservations have brought bison back to native lands as livestock. The Iinnii Initiative of the Blackfoot Confederacy is one example of a large, landscape restoration effort to bring bison back to fill their ecological niche and the historical cultural role for native peoples. The goal of the Initiative is to restore bison which are central to the historical, cultural and ecological legacy of the region, conveying multiple benefits to the Blackfeet and providing native peoples the opportunity to reconnect with a living symbol of their ancient culture. The Iinnii Initiative also seeks to connect restoration efforts to the economic sustainability of communities.

2.7.3 Recreation Values

The presence of publicly managed bison has the potential to bring increased tourism and hunting dollars to local economies. In a situation that would allow for fair chase hunting, the presence of bison has the potential to create new and unique hunting opportunities for Montana's sportsmen and women. Recreation and hunting outfitters are permitted on specific National Forests, hunting districts, or locations and could be impacted by a potential restoration program. Bison presence on a landscape could offer additional opportunities or complicate activities historically pursued in an area if use regulations were altered due to bison presence.

MFWP utilizes hunting as a wildlife management tool, which in turn, generates public interest in the conservation of wildlife. Public access would be required for public hunting and wildlife viewing in any restoration program. Any hunting or viewing program would have to be agreed upon by working group, MFWP and landowner(s) to include clarification of financial incentives (or not) for allowing public access. Bison have been hunted and

viewed in Montana when they migrate out of Yellowstone National Park since 2005. Tribes harvested 172 bison during the 2014-2015 season while state hunters harvested 42 bison.

Region	Type of Tag	Resident Fee	Nonresident Fee	Estimated Annual Revenue to Management Agency
Alaska	General Bison Tag	$25	$450 nonresident	$350,000
			$650 alien nonresident	
Arizona	Bull	$1,113	$5,415	$230,000 (high permit year – 2014) $74,000 (low permit year - 2013)
	Cow or Yearling	$663	$3,265	
	Yearling	$363	$1,765	
Alberta	General Bison Tag	$50	NA	$40,000
British Columbia	Trophy Bull	$70	$700	$80,000
South Dakota	Non-Trophy Bull	$2,256	$2,256	$50,000
	Cow	$1,756	$1,756	
Utah- Henry Mountains	General Bison Tag	$413	$1,518	$130,000
Utah- Antelope Island	General Bison Tag	$1,110	$2,615	$35,000
Wyoming	Cow/Calf	$252	$1,002	$205,000
Montana	Either sex	$125	$750	$139,000

Table 2. The cost of bison tags/permits by area for the 2014 season as well as the estimated annual revenue brought in by the sale of tags.

Around 230,000 hunters take advantage of hunting opportunities in the state and contribute tens of millions of dollars in license fees that help fund MFWP. Bison hunting or the presence of bison could negatively impact other hunting opportunities to include big game, upland game bird, and waterfowl hunting if the presence of bison within an area was a deterrent to hunters in pursuit of other species.

Outfitters in Montana offer clients a variety of recreational opportunities throughout the state including guided services for hunting, fishing, trail rides, mountain biking, and cross-country skiing. Outfitters are permitted on specific National Forests, hunting districts, or locations. Outfitters could be impacted by a potential restoration program, along with other outdoor recreationists. Bison presence on a landscape could offer additional opportunities for guiding hunters and wildlife viewers, but could also complicate activities historically pursued in an area if use regulations were altered due to bison presence.

About 50% of surveyed resident and non-resident visitors to YNP indicated that seeing bison was a reason for their trip, and about 5% said they would not have come to the area if bison had not been present (Duffield et al. 2000a,b). Regions around Yellowstone and

Glacier National Parks receive large amounts of tourism revenue due to the millions of annual visitors to the national parks that also visit the surrounding states.

Montana has hosted roughly 10 million visits from non-residents each year since 2005 (Grau, 2013). The combined spending of 2011-2012 resident and nonresident travel within the state was $3.6 billion in local spending, which supports $2.9 billion of economic activity in the state, and supports an additional $1.6 billion of economic activity, indirectly (Grau, 2013). Bison restoration could be a way to increase tourism revenue in additional areas of the state assuming public viewing access was established and promoted as part of the restoration effort.

The National Bison Range complex receives an average of 125,000 annual visitors (USFWS, 2014). Visitors come from all over the Nation and the world to learn about and enjoy a variety of wildlife dependent on the complex that includes the National Bison Range property, Ninepipe National Wildlife Refuge, Pablo National Wildlife Refuge, and the Northwest Montana Wetland Management District. In 2012, approximately 203,500 resident and nonresident visitors viewed and photographed wildlife, hunted, fished, and participated in events and programs. Fifty thousand visitors came for wildlife photography opportunities and 40,000 visitors came specifically to the National Bison Range Visitor Center (USFWS, 2014). The most popular activity for visitors is driving the 19-mile Red Sleep Mountain Drive on the Bison Range. This route offers spectacular scenery and opportunities to view and photograph wildlife.

2.8 Costs of Bison Management

(More information on program costs are provided within the case studies of Chapter 4 and Section 4.4.7)

FWP expenses for bison-related management activities, which could include hazing, response to landowner calls and public safety incidences, and assistance for other partners could be included under the existing budgets for regional wildlife management, enforcement duties, and general administration. However, additional costs for these activities could be unsustainable. Depending upon the alternative chosen, costs to FWP or other agencies could be zero or substantial. It is difficult to define possible additional costs because it is unknown at what level management would be required.

Fully confined herds can be the most costly to manage. The USFWS National Bison Range 2011 operating budget was approximately $2,095,000 for wildlife management, site maintenance, visitor services, law enforcement, and personnel costs. Within Custer State Park bison are managed alongside other species so while there is not a separate bison management budget some costs are directly bison related and are estimated to be around $60,000 annually. The Raymond Ranch in Arizona has an annual operating budget of approximately $100,000.

The confined herd programs that were examined in FWP's Interim Translocation of Bison EA (2011) showed start up costs for fencing, gates, handling facilities, equipment, water

infrastructure, and personnel to range from $840,000 to over $1 million depending upon the translocation site and the existing facilities there. The estimated annual costs for personnel, fencing, facility maintenance, etc. could be around $140,000 annually to manage a herd of approximately 40 bison (Interim Translocation of Bison EA, 2011).

The Buffalo Expansion Feasibility Study from Oglala Sioux Parks and Recreation Authority identified four alternatives given the landscape, its boundaries, and the desire to create a wild, free-roaming herd. The alternatives show size of the area, herd goals and required fencing estimated to cost $15,000/mile. The different alternatives have different landscape and geography challenges which influence the amount of fencing needed and the number of bison suitable for restoration. They estimated cost of corrals large enough to handle the buffalo herd and meet National Park Service specifications is $500,000. All alternatives could be expected to employ at least one GS-5 through GS-7 Full Time Equivalent (FTE) at current rates of $31,000 to $39,000 (Licht, 2014).

The Canadian government has committed 6.4 million dollars over a five year period to fund a bison restoration program of 600-1,000 bison in Banff National Park. The herd size is based on the estimated number of bison that could be supported on 25% of the available winter forage in the park. While containing bison within the park through fencing is a fundamental requirement for the project, fencing must be used in such a way as to avoid degrading habitat and population connectivity for other wildlife in the park. A combination of fencing and natural topographic barriers will be used to discourage bison from moving onto provincial lands, transportation corridors or other areas in the park. Parks Canada will undertake intensive on-the-ground efforts to evaluate and adapt the fencing to ensure it is permeable for other wildlife. This will involve using pre-existing baseline information on wildlife movement in the park and conducting fence permeability monitoring before and throughout the bison reintroduction. All bison released will have numbered ear tags, and a subset of the herd will be fitted with satellite-linked GPS collars. Their location, patterns of habitat use, and survival will be monitored remotely via satellite and by regular direct observation of the herd. Intense monitoring efforts as described add greatly to the overall project costs but can be conducted with local employees.